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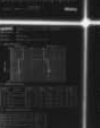
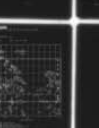
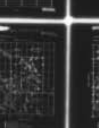
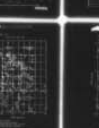
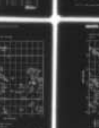
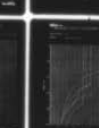
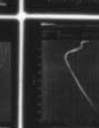
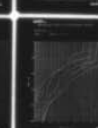
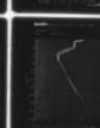
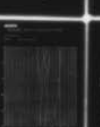
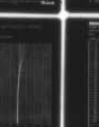
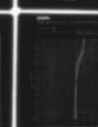
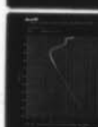
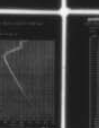
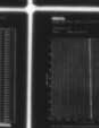
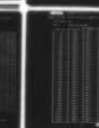
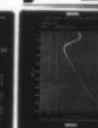
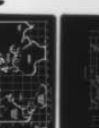
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ACOUSTIC ENVIRONMENTAL SUMMARY FOR NORTH ATLANTIC OCEAN AREA NA--ETC(U)
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NAVAL UNDERSEA RESEARCH AND DEVELOPMENT CENTER
An activity of the Naval Material Command

Charles B. Bishop, Captain, USN
Commander

Wm. B. McLean, Ph.D.
Technical Director

14 NUC-TN-231

9 Technical Note

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ACOUSTIC ENVIRONMENTAL SUMMARY
FOR
NORTH ATLANTIC OCEAN AREA NA-1.4

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This technical note presents summary oceanographic data which has been generated by the Performance Modeling and Operations Analysis Division, Code 556, of the Naval Underseas Warfare Center, San Diego. This note is not to be considered as an official NUWC report. Its purpose is to document environmental studies which are being carried out in support of current Navy ASW acoustic studies.

The work described in this technical note has been supported under NAVSHIPS Exploratory Development subproject SF 11-121-500, Task 8704, and by Independent Research funds under subproject ZR 011 01 01, Task 0401.

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CONTENTS

INTRODUCTION

ENVIRONMENTAL SUMMARY OF NORTH ATLANTIC AREA NA-1. 32°-38°N x 56°-62°W

Section I	General Summary Description . . . I.1
Section II	Winter Statistical Summary Data . . . II.1
Section III	Spring Statistical Summary Data . . . III.1
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INTRODUCTION

This report forms a part of a continuing series of reports published by Code 556 to provide acoustic system oriented users a concise but comprehensive analysis of acoustically significant oceanographic parameters. The analysis approach and a detailed description of the methods employed appears in NUC Technical Paper No. 115.

This report presents a seasonal oceanographic environmental summary for North Atlantic area NA-1. Figure I.1 shows the region from which data was taken for this analysis.

(Northeast of Bermuda -- 33-38 deg N x 56-62 deg W.)

The contents of this environmental summary represent a statistical cross section of the conditions which can exist in this region. Velocity structure data resulted from an analysis of Nansen cast and bathythermograph data from the Code 556 digital oceanographic data bank, which includes 260,000 Nansen cast stations and 304,000 BT stations. Additional environmental data from Code 556 files, NAVOCEANO publications and from various other sources provided additional information. Special Code 556 computer processing programs, which determine layer depth, gradients, and other profile characteristics, were used in carrying out the velocity profile analysis.

Data generated for this report is primarily for use by NUC system analysts in selecting environmental inputs to sonar system performance predictions. They are also available to other Navy activities requiring information of this type in support of system analysis studies.

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Sufficient data exists so that a high confidence level can be assigned to the statistical validity of velocity profile information presented in this report. We may also establish a high confidence level in the sea surface parameters since sufficient data is available. Lack of good data limits our knowledge of scattering coefficients, and we must therefore ascribe a lower confidence level to these values.

Core and other ocean bottom sediment information provided by the Marine Geophysical Survey and other surveys furnished data for a satisfactory description of acoustic properties of the sea floor in the area.

Values appearing in the Statistical Quartile Summary Tables are not always consistent with the layer depth (ZL) and gradient (γ_0 and γ_1) values presented in the Environmental Summary Table. This is expected since the Statistical Quartile Summary Table values result from using all station data sets available, while values appearing in the Environmental Summary Table utilize only those station data sets which display surface channel characteristics.

These environmental summaries will be updated at periodic intervals as additional data or information becomes available.

Depending upon the application, the acoustician utilizing these statistical profiles may desire to make a slight modification of the near surface profile in order to exhibit the sound channel which he desires to use in his analysis.

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Users of this environmental summary must realize that all parameter values appearing in this report represent a cross section of possible values one might expect to occur based on a complete review of available historical data and consideration of local area dynamics.

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SECTION I

GENERAL SUMMARY DESCRIPTION

I.1

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ENVIRONMENTAL PROFILE SUMMARY

LOCATION/AREA: NA-1

I. GENERAL DESCRIPTION OF REGION:

Area NA-1, located northeast of Bermuda, is south of the Gulf Stream and out of the influence of this strong current system. Sound velocity data derived from oceanographic station data display relatively uniform profiles in winter and summer seasons. Spring and fall are transition seasons and display the pronounced effect of surface cooling and warming in the variability of surface temperature (SST) and velocity (CS), layer depth (ZL) and the probability of surface sound channel occurrence. Bottom depths generally exceed 16,000 feet. The two significant physiographic provinces are the Bermuda Rise to the southwest and the Sohm Abyssal Plain.

II. TECHNIQUE OF ANALYSIS AND DATA BASE:

Adequate data is available for spring and summer seasons. Winter data includes only 6 observations and fall includes 14 observations. Supplementary BT data confirms the analysis values presented in the seasons of sparse data.

III. SUMMARY OCEANOGRAPHIC CHARACTERISTICS:

A. SOUND VELOCITY PROFILE CHARACTERISTICS:

Sound velocity profiles reflect seasonal changes with well defined deep surface channels occurring most of the time in winter. Much shallower channels dominate the summer season.

B. SEA SURFACE CHARACTERISTICS:

Sea surface characteristics adequately define the four seasons of the area. Annual sea surface temperature range is 62°F-80°F. Low variability occurs in winter and summer.

C. SEA FLOOR CHARACTERISTICS:

Bottom depth in the area is generally greater than 16,000 feet rising in the southwest section of the area to about 15,000 feet over the Bermuda Rise physiographic province. The Sohm Abyssal Plain province occupies the deepest portions of the area.

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GENERAL AREA LOCATION

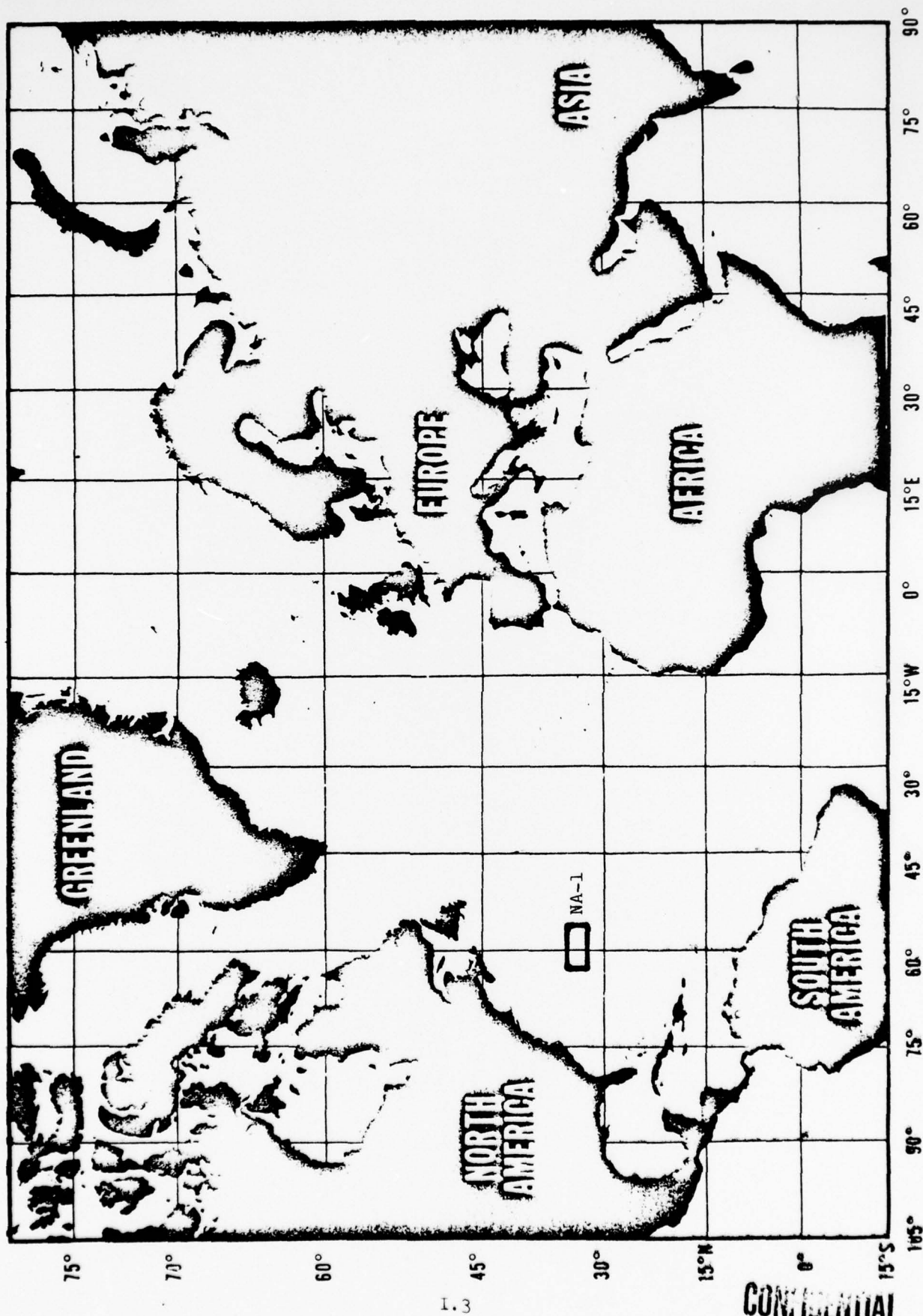


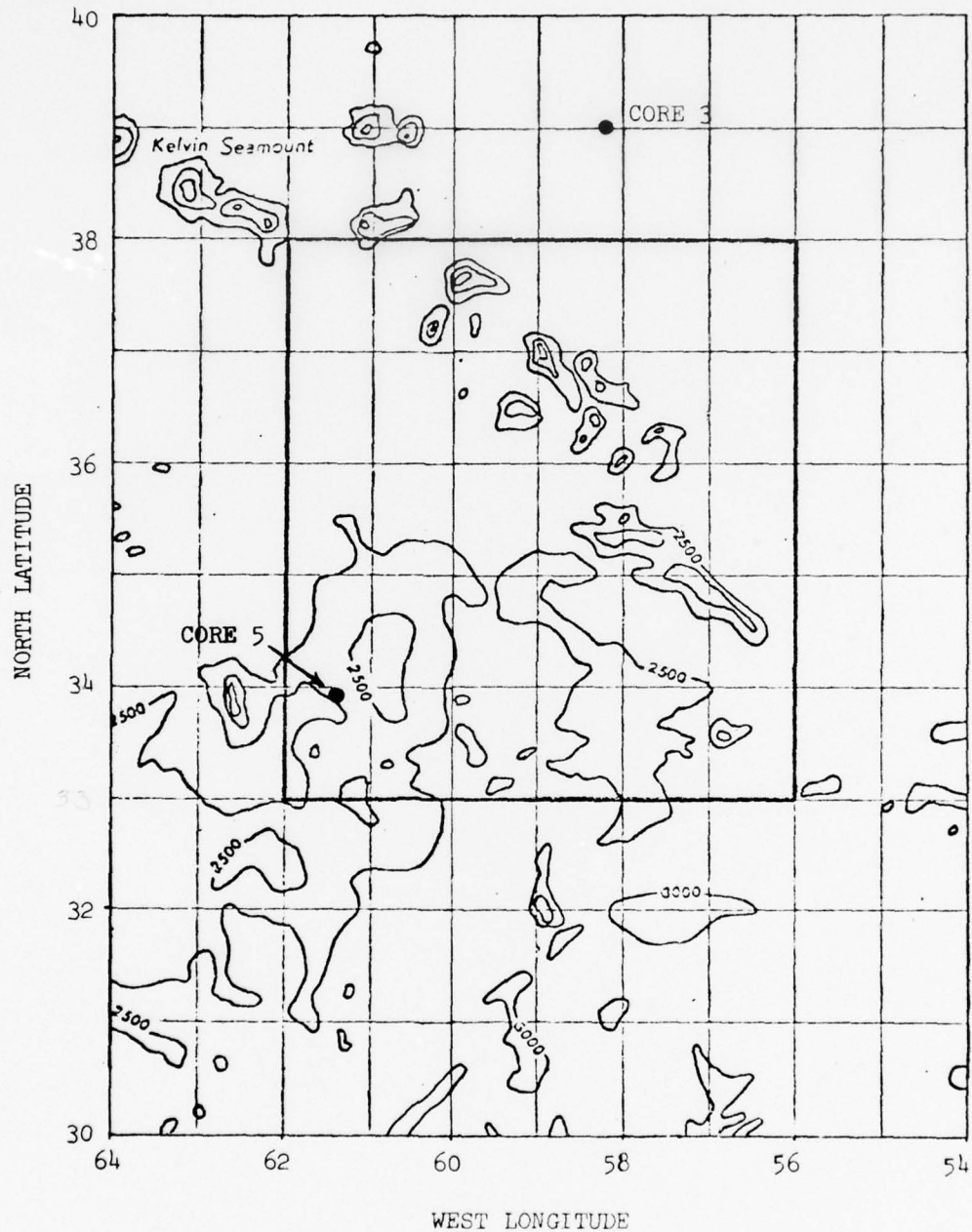
Figure I-1. Location map for area NA-1.

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DATA ANALYSIS AREA

LOCATION/AREA: NA-1



CORE 3 - NAVOCEANO SP 96-1-5, MGS Area 1, Bermuda Rise

CORE 5 - NAVOCEANO SP 96-1-5, MGS Area 1, Sohm Abyssal Rise

CORE LOCATIONS

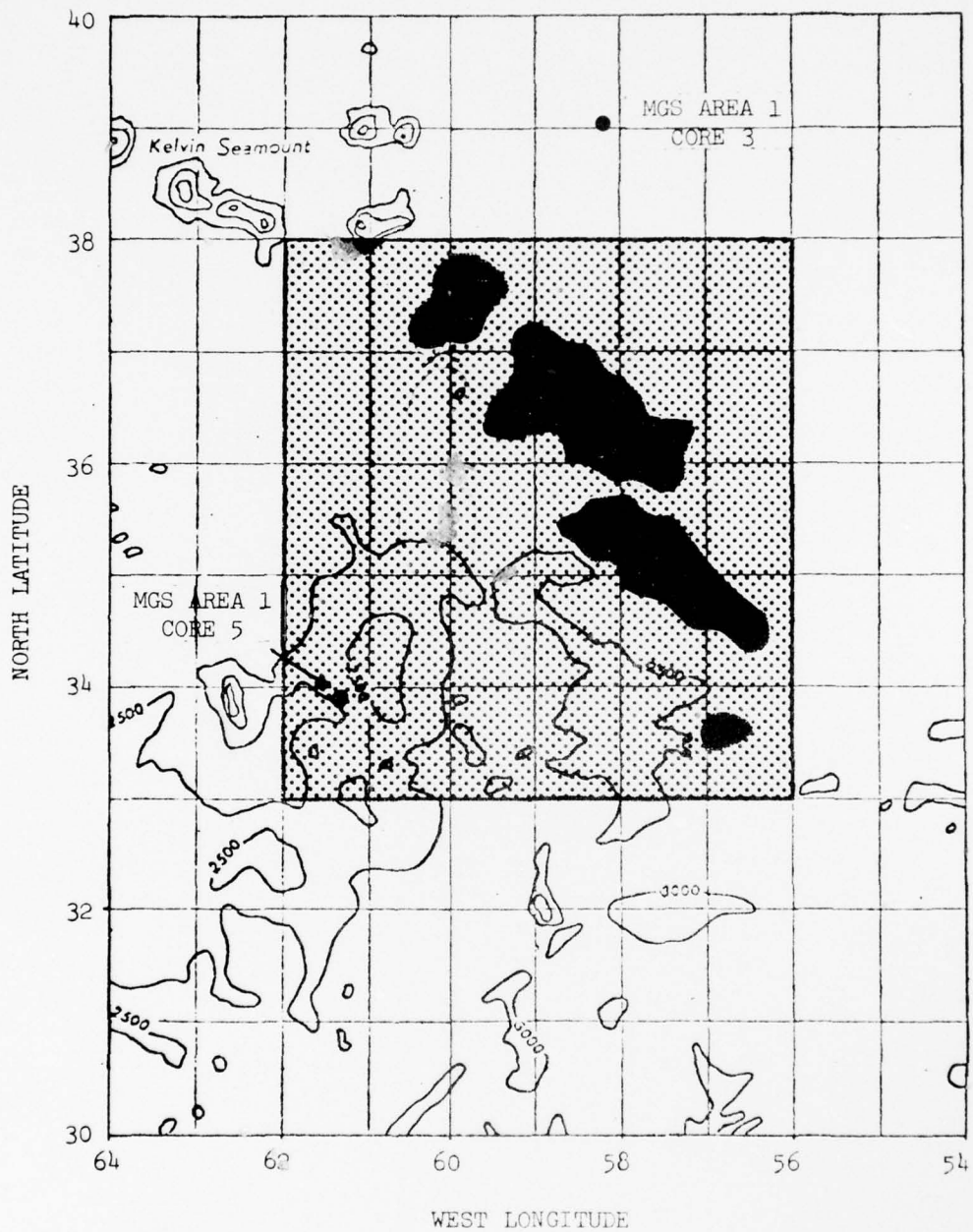
FIG. I.2 Data Analysis Area

I.4 **CONFIDENTIAL**

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DATA ANALYSIS AREA

LOCATION/AREA: NA-1





-  Indicates bottom slope greater than 6°.
-  Indicates bottom slope less than 6°.

FIG. I.3. General Bottom Relief and Roughness

SECTION II
WINTER STATISTICAL SUMMARY DATA

II.1

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TABLE II.1 ENVIRONMENTAL SUMMARY, WINTER

LOCATION/AREA: NA-1

SEASON: WINTER (JAN, FEB, MAR)

SURFACE SOUND CHANNEL CHARACTERISTICS

	ASSOCIATED GRADIENTS*	
LAYER DEPTH	IN-LAYER	BELOW-LAYER
(ZL)	(Y ₀)	(Y ₁)
(FT)	(FT/SEC/FT)	(FT/SEC/FT)

1ST QUARTILE		
1126	+0.0160	-0.0226
MEDIAN		
1358	+0.0160	-0.0385
3RD QUARTILE		
1676	+0.0075	-0.0577

STATION

BT

AMOUNT OF
DATA USED

6

200

PROBABILITY
OF SURFACE
CHANNEL
OCCURRENCE

>90%

ENVIRONMENTAL CHARACTERISTICS

SURFACE PARAMETERS

	1ST QUARTILE	MEDIAN	3RD QUARTILE
SOUND VELOCITY (CS)(FT/SEC)	4979.1	4982.4	4985.4
TEMPERATURE (SST)(°F)	64.1	64.7	65.3
WAVE HEIGHT (LWA)(FT)	3.0	5.6	10.6
WIND VELOCITY (VWI)(KNOTS)	17.0	22.0	27.0

SEA FLOOR PARAMETERS

BOTTOM DEPTH (ZBM)(FT)	15,500	16,250	16,800
BOTTOM POROSITY (PORB)	.55	.70	.75

SCATTERING STRENGTH PARAMETERS

OCEAN BOTTOM (MUB)(dB/SQ YD)	-20	-17	-14
LAYER (MUVL)(dB/CU YD)	-85	-79	-73
VOLUME (MUV)(dB/CU YL)	-85	-80	-75

*Associated gradients are medians for that 50% of the data centered about the specified layer depth quartile values.

II.2

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DEEP OCEAN STATISTICAL QUARTILE PLOT

LOCATION/AREA: NA-1

SEASON: WINTER (JAN, FEB, MAR)

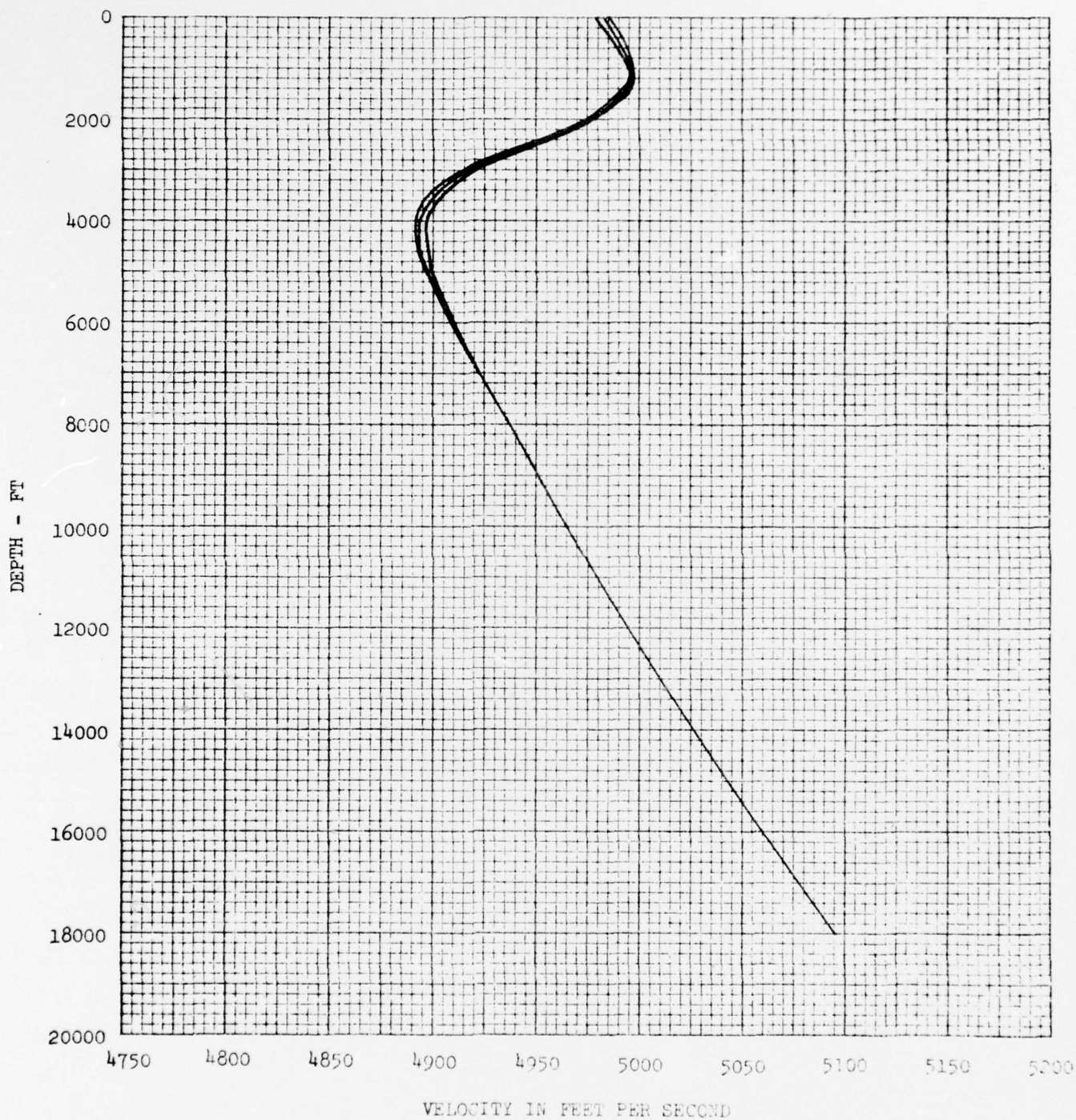


FIG. II.1. Deep Ocean Sound Velocity Statistical Quartile Plot, Winter

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CONFIDENTIAL TABLE II.11
DEEP OCEAN STATISTICAL QUARTILES

LOCATION/AREA: NA-1

SEASON: WINTER (JAN, FEB, MAR)

DEPTH - FT	SOUND VELOCITY - FPS		
	1ST QUARTILE	MEDIAN	3RD QUARTILE
0	4979.1	4982.4	4985.4
200	4982.7	4985.5	4988.6
400	4986.1	4988.4	4991.2
600	4989.3	4991.0	4993.7
800	4992.4	4993.7	4995.3
1000	4994.7	4996.1	4996.8
1200	4995.8	4996.8	4997.3
1400	4991.8	4994.5	4997.0
1600	4987.0	4989.7	4991.2
1800	4981.6	4983.8	4985.1
2000	4975.0	4976.9	4978.6
2200	4962.6	4966.2	4968.2
2400	4950.3	4954.1	4956.6
2600	4938.1	4940.5	4944.2
2800	4926.0	4927.6	4931.5
3000	4914.9	4916.3	4919.9
3200	4906.9	4909.6	4912.1
3400	4900.8	4904.0	4906.4
3600	4895.9	4899.3	4902.2
3800	4893.5	4896.0	4898.6
4000	4891.9	4893.8	4896.4
4200	4891.6	4893.9	4896.8
4400	4892.4	4894.0	4897.3
4600	4893.6	4894.1	4897.8
5000	4896.8	4897.4	4900.1
5400	4901.1	4901.5	4903.9
6000	4908.1	4908.4	4909.9
7000	4921.7	4922.4	4922.4
8000	4936.6	4937.1	4937.2
9000	4950.8	4950.8	4950.8
10,000	4965.4	4965.4	4965.4
12,000	4994.3	4994.3	4994.3
14,000	5026.2	5026.2	5026.2
16,000	5060.0	5060.0	5060.0
18,000	5095.5	5095.5	5095.5

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NEAR SURFACE SOUND VELOCITY PROFILE

LOCATION/AREA: NA-1

SEASON: WINTER (JAN, FEB, MAR)

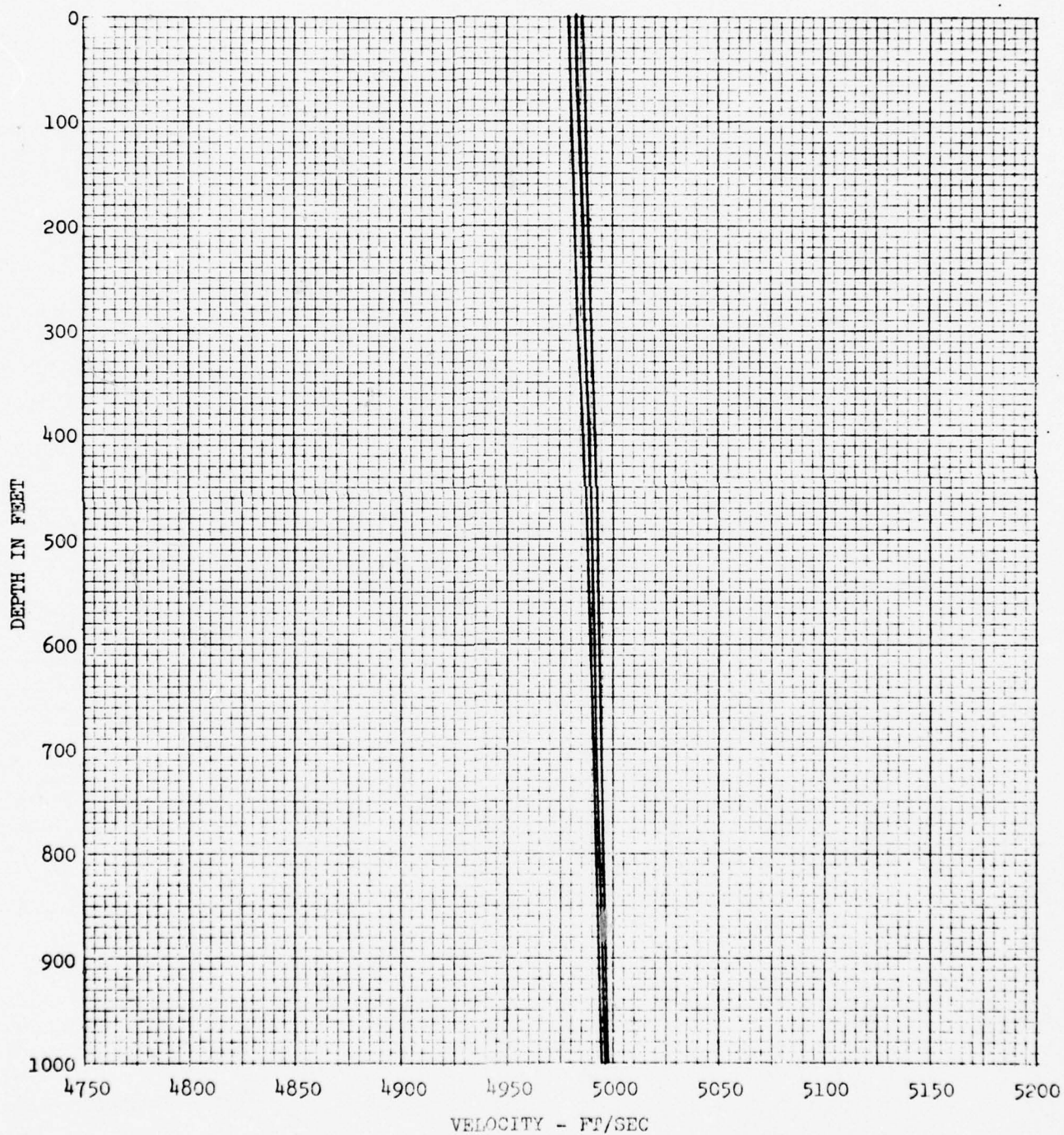


FIG. II.2. Near Surface Sound Velocity Statistical Quartile Plot, Winter
II.5

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CONFIDENTIALTABLE II.111
NEAR SURFACE STATISTICAL QUARTILES

LOCATION/AREA: NA-1

SEASON: WINTER (JAN, FEB, MAR)

DEPTH - FT	SOUND VELOCITY - FPS		
	1ST QUARTILE	MEDIAN	3RD QUARTILE
0	4979.1	4982.4	4985.4
20	4979.5	4982.9	4985.8
40	4979.8	4983.3	4986.2
60	4980.1	4983.6	4986.6
80	4980.5	4983.9	4987.0
100	4980.8	4984.1	4987.4
120	4981.2	4984.4	4987.6
140	4981.6	4984.7	4987.9
160	4981.9	4985.0	4988.2
180	4982.3	4985.2	4988.4
200	4982.7	4985.5	4988.6
240	4983.4	4986.1	4989.0
280	4984.0	4986.7	4989.6
320	4984.7	4987.3	4990.1
360	4985.4	4987.9	4990.7
400	4986.1	4988.4	4991.2
440	4986.7	4989.0	4991.8
480	4987.4	4989.4	4992.3
520	4988.0	4990.0	4992.8
560	4988.6	4990.5	4993.3
600	4989.3	4991.0	4993.7
640	4989.9	4991.5	4994.2
680	4990.6	4992.0	4994.5
720	4991.2	4992.6	4994.8
760	4991.8	4993.2	4995.0
800	4992.4	4993.7	4995.3
840	4992.9	4994.3	4995.6
880	4993.4	4994.8	4995.9
920	4993.8	4995.2	4996.2
960	4994.3	4995.7	4996.5
1000	4994.7	4996.1	4996.8

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SECTION III
SPRING STATISTICAL SUMMARY DATA

III.1

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TABLE III.1 ENVIRONMENTAL SUMMARY, SPRING

LOCATION/AREA: NA-1

SEASON: SPRING (APR, MAY, JUN)

SURFACE SOUND CHANNEL CHARACTERISTICS

LAYER DEPTH (ZL) (FT)	ASSOCIATED GRADIENTS*		STATION	AMOUNT OF DATA USED	PROBABILITY OF SURFACE CHANNEL OCCURRENCE
	IN-LAYER (γ_0) (FT/SEC/FT)	BELOW-LAYER (γ_1) (FT/SEC/FT)			
1ST QUARTILE			BT	61	48%
157	+0.0121	-0.0270		200	
MEDIAN					
267	+0.0101	-0.0201			
3RD QUARTILE					
1328	+0.0100	-0.0307			

ENVIRONMENTAL CHARACTERISTICS

SURFACE PARAMETERS

	1ST QUARTILE	MEDIAN	3RD QUARTILE
SOUND VELOCITY (CS)(FT/SEC)	4989.3	5007.7	5034.6
TEMPERATURE (SST)(°F)	66.1	69.8	75.8
WAVE HEIGHT (LWA)(FT)	3.2	5.8	10.8
WIND VELOCITY (VWI)(KNOTS)	7.0	14.0	21.0

SEA FLOOR PARAMETERS

BOTTOM DEPTH (ZBM)(FT)	15,500	16,250	16,800
BOTTOM POROSITY (PORB)	.55	.70	.75

SCATTERING STRENGTH PARAMETERS

OCEAN BOTTOM (MUB)(dB/SQ YD)	-20	-17	-14
LAYER (MUVL)(dB/CU YD)	-85	-76	-67
VOLUME (MUV)(dB/CU YD)	-85	-80	-75

*Associated gradients are medians for that 50% of the data centered about the specified layer depth quartile values.

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DEEP OCEAN SOUND VELOCITY PROFILE

LOCATION/AREA: NA-1

SEASON: SPRING (APR, MAY, JUN)

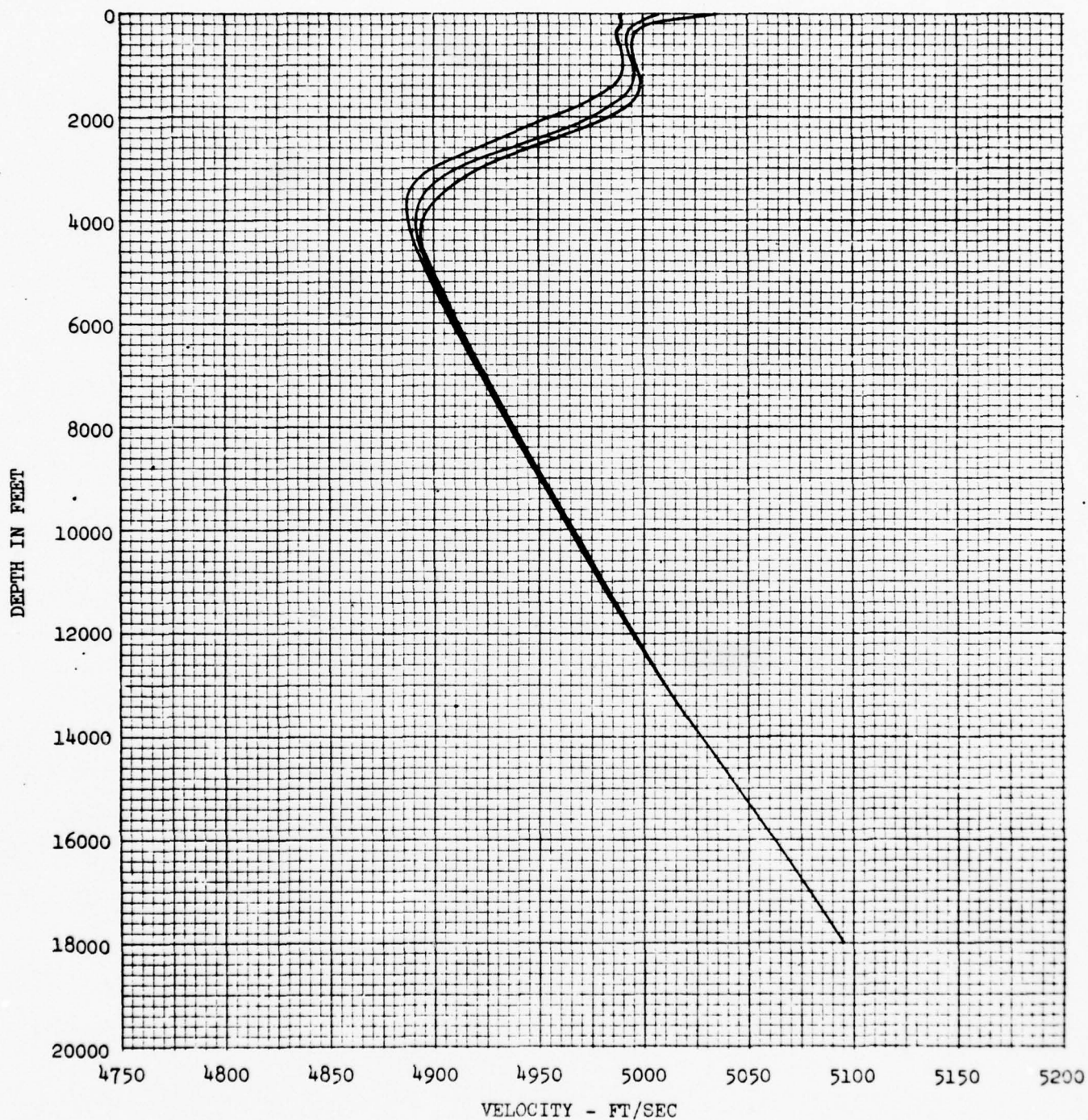


FIG. III.1 Deep Ocean Sound Velocity Statistical Quartile Plot, Spring 1967

III.3

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CONFIDENTIAL TABLE III.11
DEEP OCEAN STATISTICAL QUANTILES

LOCATION/AREA: NA-1

SEASON: SPRING (APR, MAY, JUN)

DEPTH - FT	SOUND VELOCITY - FPS		
	1ST QUANTILE	MEDIAN	3RD QUANTILE
0	4989.3	5007.7	5034.6
200	4989.8	4996.7	5004.0
400	4987.3	4992.2	4995.9
600	4989.4	4992.4	4994.7
800	4990.7	4993.6	4995.4
1000	4990.4	4995.4	4997.0
1200	4990.4	4996.0	4998.3
1400	4985.4	4994.8	4998.8
1600	4978.2	4991.4	4997.7
1800	4967.2	4984.0	4992.2
2000	4955.4	4975.2	4984.7
2200	4945.1	4963.0	4972.8
2400	4933.2	4950.0	4960.1
2600	4919.8	4936.1	4946.5
2800	4908.8	4923.3	4933.5
3000	4899.0	4911.7	4921.8
3200	4892.0	4903.3	4914.1
3400	4888.4	4897.6	4907.3
3600	4887.1	4893.7	4901.1
3800	4886.9	4891.7	4897.5
4000	4887.3	4890.8	4895.0
4200	4888.8	4891.6	4894.7
4400	4890.4	4892.8	4895.1
4600	4892.1	4894.2	4896.0
5000	4896.4	4898.0	4900.1
5400	4901.3	4902.6	4904.2
6000	4908.9	4910.0	4911.0
7000	4922.6	4923.5	4924.3
8000	4936.6	4937.4	4938.4
9000	4950.3	4951.3	4952.3
10,000	4964.2	4965.3	4966.2
12,000	4994.2	4995.1	4995.7
14,000	5026.5	5027.1	5027.5
16,000	5061.7	5062.0	5062.4
18,000	5095.2	5095.2	5095.2

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NEAR SURFACE SOUND VELOCITY PROFILE

LOCATION/AREA: NA-1

SEASON: SPRING (APR, MAY, JUN)

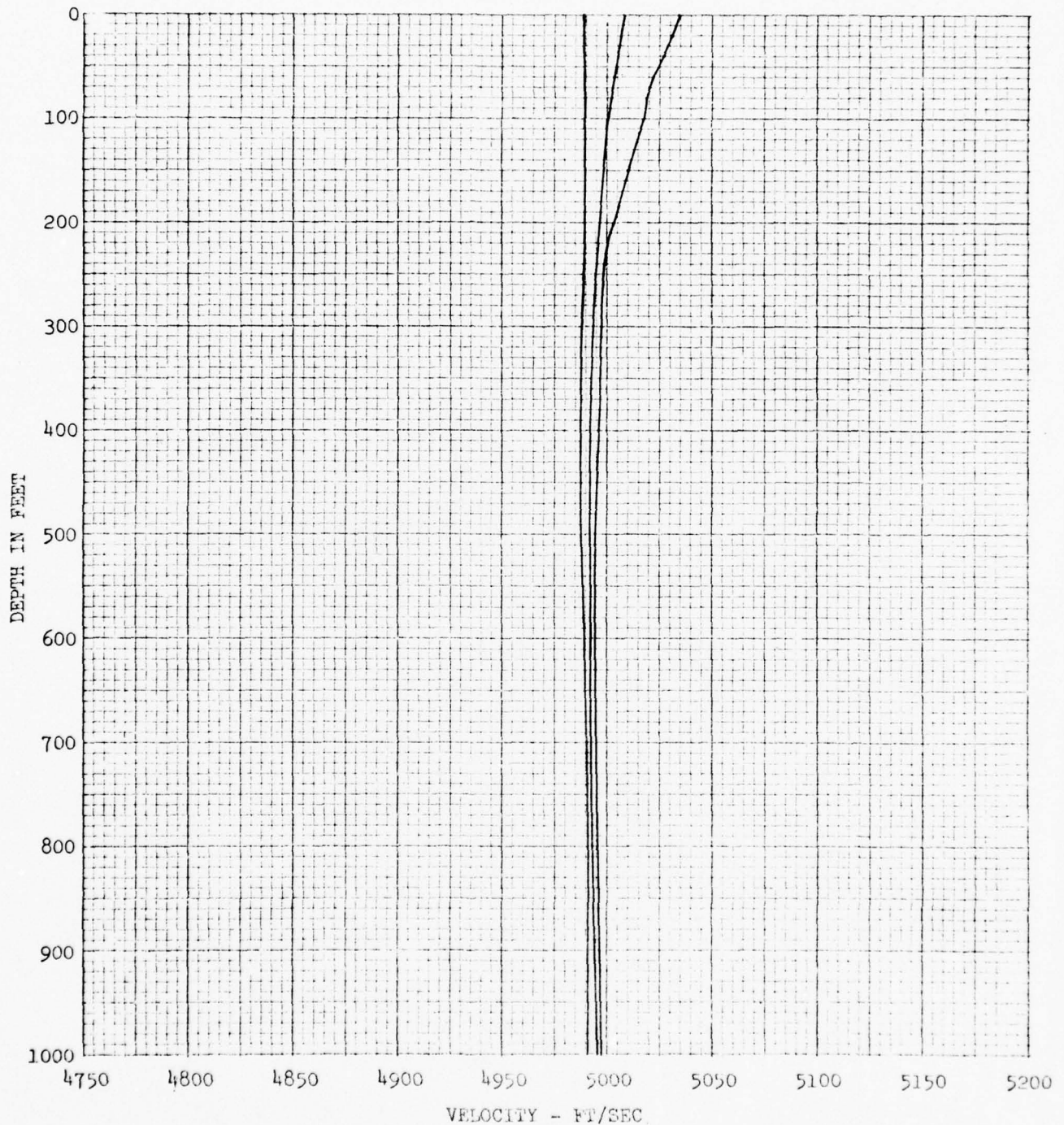


FIG. III.2. Near Surface Sound Velocity Statistical Quartile Plot, Spring

III.5

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CONFIDENTIALTABLE III.111
NEAR SURFACE STATISTICAL QUANTILES

LOCATION/AREA: NA-1

SEASON: SPRING (APR, MAY, JUN)

DEPTH - FT	SOUND VELOCITY - FPS		
	1ST QUANTILE	MEDIAN	3RD QUANTILE
0	4989.3	5007.7	5034.6
20	4989.0	5006.4	5030.8
40	4988.8	5005.0	5026.6
60	4989.1	5003.4	5021.6
80	4989.4	5001.7	5019.1
100	4989.6	5000.2	5017.5
120	4989.8	4999.7	5014.9
140	4989.9	4998.7	5011.7
160	4989.9	4998.0	5008.9
180	4989.8	4997.2	5006.6
200	4989.8	4996.7	5004.0
240	4989.6	4995.2	4998.9
280	4988.7	4994.0	4997.7
320	4987.7	4993.3	4997.2
360	4987.1	4992.4	4996.5
400	4987.3	4992.2	4995.9
440	4987.5	4992.0	4995.3
480	4987.7	4991.9	4995.0
520	4988.2	4992.0	4994.6
560	4989.0	4992.2	4994.7
600	4989.4	4992.4	4994.7
640	4990.0	4992.6	4994.8
680	4990.1	4992.9	4994.9
720	4990.3	4993.1	4995.0
760	4990.5	4993.4	4995.2
800	4990.7	4993.6	4995.4
840	4990.7	4993.7	4995.7
880	4990.6	4994.1	4996.0
920	4990.6	4994.8	4996.3
960	4990.5	4995.1	4996.7
1000	4990.4	4995.4	4997.0

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SECTION IV
SUMMER STATISTICAL SUMMARY DATA

IV.1

CONFIDENTIAL
TABLE IV.1

ENVIRONMENTAL SUMMARY, SUMMER

LOCATION/AREA: NA-1

SEASON: SUMMER (JUL, AUG, SEP)

SURFACE SOUND CHANNEL CHARACTERISTICS

ASSOCIATED GRADIENTS*
LAYER DEPTH IN-LAYER BELOW-LAYER
(ZL) (Y₀) (Y₁)
(FT) (FT/SEC/FT) (FT/SEC/FT)

1ST QUARTILE		
78	+0.0195	-0.3687
MEDIAN		
105	+0.0169	-0.1836
3RD QUARTILE		
160	+0.0164	-0.2317

STATION
BT

AMOUNT OF
DATA USED

26
200

PROBABILITY
OF SURFACE
CHANNEL
OCCURRENCE

69%

ENVIRONMENTAL CHARACTERISTICS

SURFACE PARAMETERS

SOUND VELOCITY (CS)(FT/SEC)
TEMPERATURE (SST)(°F)
WAVE HEIGHT (LWA)(FT)
WIND VELOCITY (VWI)(KNOTS)

1ST QUARTILE	MEDIAN	3RD QUARTILE
5042.4	5044.4	5046.6
77.7	78.1	79.5
3.2	5.8	9.4
4.0	11.0	18.0

SEA FLOOR PARAMETERS

BOTTOM DEPTH (ZBM)(FT)
BOTTOM POROSITY (PORB)

15,500	16,250	16,800
.55	.70	.75

SCATTERING STRENGTH PARAMETERS

OCEAN BOTTOM (MUB)(dB/SQ YD)
LAYER (MUVL)(dB/CU YD)
VOLUME (MUV)(dB/CU YD)

-20	-17	-14
-85	-74	-62
-85	-80	-75

*Associated gradients are medians for that 50% of the data centered about the specified layer depth quartile values.

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DEEP OCEAN STATISTICAL QUARTILE PLOT

LOCATION/AREA: NA-1

SEASON: SUMMER (JUL, AUG, SEP)

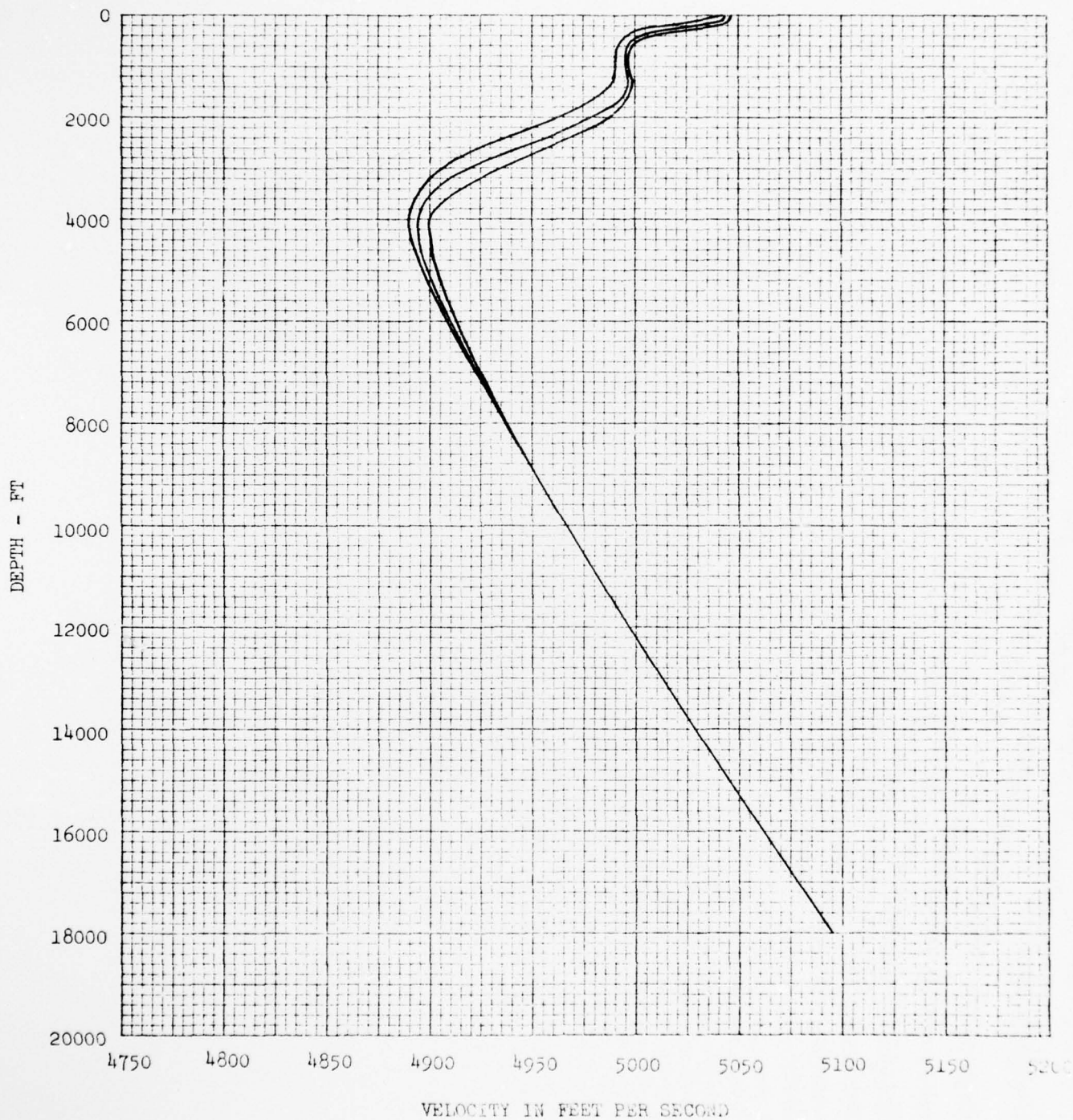


FIG. IV.1. Deep Ocean Sound Velocity Statistical Quartile Plot, Summer

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TABLE IV.11

DEEP OCEAN STATISTICAL QUANTILES

LOCATION/AREA: NA-1

SEASON: SUMMER (JUL, AUG, SEP)

DEPTH - FT	SOUND VELOCITY - FPS		
	1ST QUANTILE	MEDIAN	3RD QUANTILE
0	5042.4	5044.4	5046.6
200	5018.5	5027.1	5034.1
400	4996.1	5002.9	5007.8
600	4992.0	4996.2	4998.2
800	4991.0	4995.4	4997.0
1000	4990.5	4995.6	4997.4
1200	4990.5	4996.4	4997.8
1400	4987.2	4996.4	4997.5
1600	4981.0	4994.7	4996.7
1800	4972.8	4987.4	4993.2
2000	4963.3	4978.7	4988.1
2200	4949.7	4969.3	4978.7
2400	4936.4	4957.2	4968.2
2600	4923.4	4942.5	4956.5
2800	4913.6	4930.4	4945.5
3000	4905.2	4919.3	4934.6
3200	4899.5	4910.9	4924.2
3400	4895.7	4904.0	4915.9
3600	4893.1	4898.2	4909.0
3800	4891.0	4896.0	4903.7
4000	4889.7	4894.3	4900.1
4200	4889.9	4893.6	4900.1
4400	4891.1	4894.3	4900.5
4600	4892.8	4895.7	4901.1
5000	4896.8	4898.9	4902.8
5400	4901.4	4903.3	4906.6
6000	4908.8	4910.2	4912.7
7000	4922.7	4923.1	4924.8
8000	4937.3	4937.5	4938.1
9000	4951.4	4951.7	4952.1
10,000	4965.6	4966.0	4966.4
12,000	4996.0	4996.2	4996.9
14,000	5027.8	5027.8	5027.8
16,000	5061.1	5061.1	5061.1
18,000	5095.2	5095.2	5095.2

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NEAR SURFACE SOUND VELOCITY PROFILE

LOCATION/AREA: NA-1

SEASON: SUMMER (JUL, AUG, SEP)

BEST AVAILABLE COPY

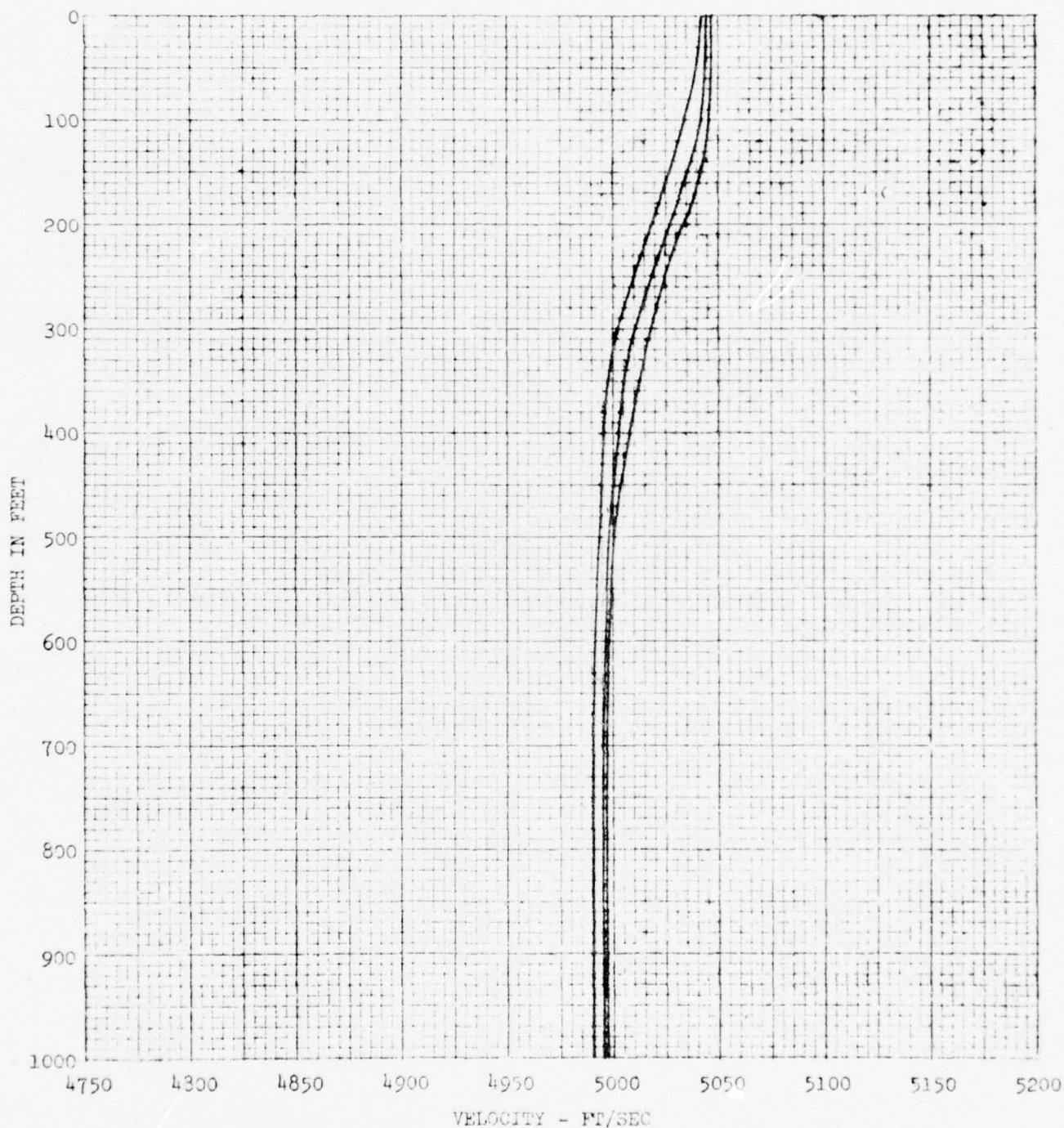


FIG. IV.2. Near Surface Sound Velocity Statistical Quartile Plot, Summer

IV.5

CONFIDENTIAL

CONFIDENTIALTABLE IV.111
NEAR SURFACE STATISTICAL QUARTILES

LOCATION/AREA: NA-1

SEASON: SUMMER (JUL, AUG, SEP)

DEPTH - FT	SOUND VELOCITY - FPS		
	1ST QUARTILE	MEDIAN	3RD QUARTILE
0	5042.4	5044.4	5046.6
20	5041.5	5044.2	5046.6
40	5040.4	5043.8	5046.6
60	5039.0	5043.2	5046.4
80	5036.8	5043.0	5046.2
100	5034.2	5042.6	5045.8
120	5031.5	5039.6	5044.8
140	5028.2	5037.0	5043.4
160	5025.0	5033.8	5040.5
180	5021.8	5030.7	5037.4
200	5018.5	5027.1	5034.1
240	5011.7	5020.3	5026.1
280	5005.2	5013.8	5020.8
320	5000.2	5008.0	5016.0
360	4997.0	5004.7	5011.9
400	4996.1	5002.9	5007.8
440	4995.2	5000.8	5004.5
480	4994.6	4999.6	5001.8
520	4993.2	4997.5	4999.9
560	4992.4	4997.1	4998.8
600	4992.0	4996.2	4998.2
640	4991.2	4996.1	4997.6
680	4990.8	4995.6	4997.3
720	4990.9	4995.5	4996.9
760	4990.9	4995.4	4997.0
800	4991.0	4995.4	4997.0
840	4990.9	4995.4	4997.1
880	4990.8	4995.4	4997.2
920	4990.7	4995.4	4997.2
960	4990.6	4995.5	4997.3
1000	4990.5	4995.6	4997.4

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SECTION V
FALL STATISTICAL SUMMARY DATA

V.1

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TABLE V.1

ENVIRONMENTAL SUMMARY, FALL

LOCATION/AREA: NA-1

SEASON: FALL (OCT, NOV, DEC)

SURFACE SOUND CHANNEL CHARACTERISTICS

ASSOCIATED GRADIENTS*

LAYER DEPTH (ZL) (FT)	IN-LAYER (γ_0) (FT/SEC/FT)	BELOW-LAYER (γ_1) (FT/SEC/FT)
-----------------------------	---	--

1ST QUARTILE		
159	+0.0163	-0.1531
MEDIAN		
202	+0.0172	-0.0679
3RD QUARTILE		
307	+0.0167	-0.0392

STATION

BT

AMOUNT OF
DATA USED

14
200

PROBABILITY
OF SURFACE
CHANNEL
OCCURRENCE

>85%

ENVIRONMENTAL CHARACTERISTICSSURFACE PARAMETERS

	1ST QUARTILE	MEDIAN	3RD QUARTILE
SOUND VELOCITY (CS)(FT/SEC)	5004.7	5015.0	5030.5
TEMPERATURE (SST)(°F)	69.1	70.3	75.0
WAVE HEIGHT (LWA)(FT)	2.7	4.4	8.5
WIND VELOCITY (VWI)(KNOTS)	9.0	18.0	26.0

SEA FLOOR PARAMETERS

BOTTOM DEPTH (ZBM)(FT)	15,500	16,250	16,800
BOTTOM POROSITY (PORB)	.55	.70	.75

SCATTERING STRENGTH PARAMETERS

OCEAN BOTTOM (MUB)(dB/SQ YD)	-20	-17	-14
LAYER (MUVL)(dB/CU YD)	-85	-75	-65
VOLUME (MUV)(dB/CU YD)	-85	-80	-75

*Associated gradients are medians for that 50% of the data centered about the specified layer depth quartile values.

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DEEP OCEAN STATISTICAL QUARTILE PLOT

LOCATION/AREA: NA-1

SEASON: FALL (OCT, NOV, DEC)

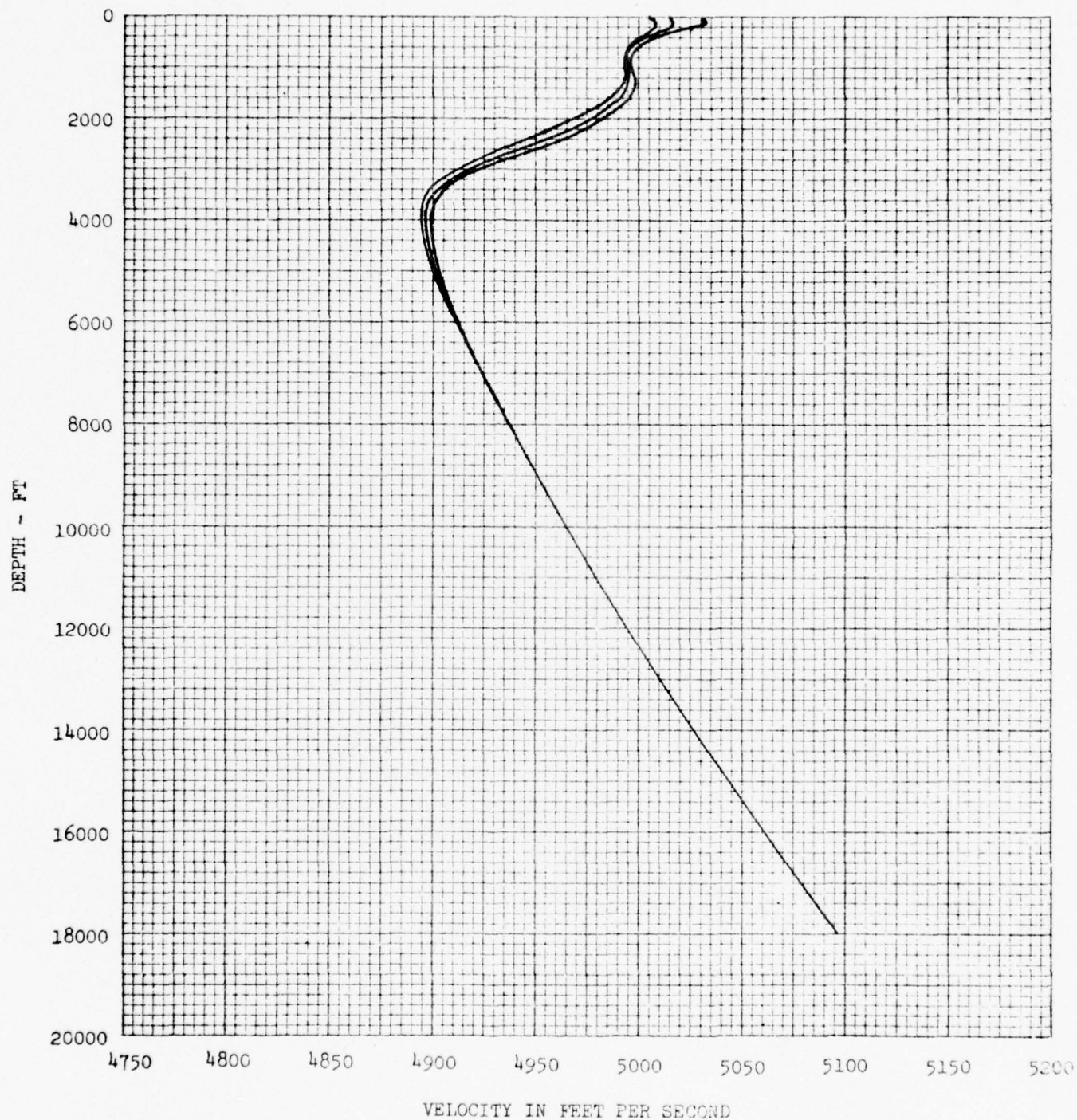


FIG. V.1. Deep Ocean Sound Velocity Statistical Quartile Summary, Fall

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TABLE V.11

DEEP OCEAN STATISTICAL QUANTILES

LOCATION/AREA: NA-1

SEASON: FALL (OCT, NOV, DEC)

DEPTH - FT	SOUND VELOCITY - FPS		
	1ST QUANTILE	MEDIAN	3RD QUANTILE
0	5004.7	5015.0	5030.5
200	5007.6	5015.4	5025.0
400	5000.6	5003.4	5006.3
600	4994.8	4995.9	4998.7
800	4993.8	4994.5	4996.4
1000	4994.4	4995.2	4996.7
1200	4993.5	4995.5	4998.0
1400	4990.7	4994.4	4998.1
1600	4986.0	4990.9	4996.0
1800	4977.3	4983.8	4989.4
2000	4967.5	4975.7	4981.8
2200	4956.6	4966.2	4973.3
2400	4944.6	4954.8	4962.7
2600	4931.6	4941.7	4950.2
2800	4921.2	4928.6	4935.4
3000	4911.8	4916.7	4921.6
3200	4904.2	4909.0	4912.2
3400	4899.0	4902.9	4906.0
3600	4895.5	4898.0	4901.9
3800	4895.0	4897.1	4899.5
4000	4895.1	4896.8	4898.0
4200	4895.8	4897.1	4898.3
4400	4896.2	4897.8	4898.8
4600	4896.6	4898.7	4899.4
5000	4899.8	4901.1	4902.4
5400	4903.7	4904.7	4906.0
6000	4910.2	4911.0	4912.0
7000	4923.0	4923.6	4924.3
8000	4936.2	4936.9	4937.8
9000	4949.7	4950.8	4951.5
10,000	4963.5	4965.0	4965.5
12,000	4993.6	4994.6	4995.1
14,000	5025.7	5026.6	5027.0
16,000	5060.4	5061.5	5061.8
18,000	5095.5	5095.5	5095.5

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NEAR SURFACE SOUND VELOCITY PROFILE

LOCATION/AREA: NA-1

SEASON: FALL (OCT, NOV, DEC)

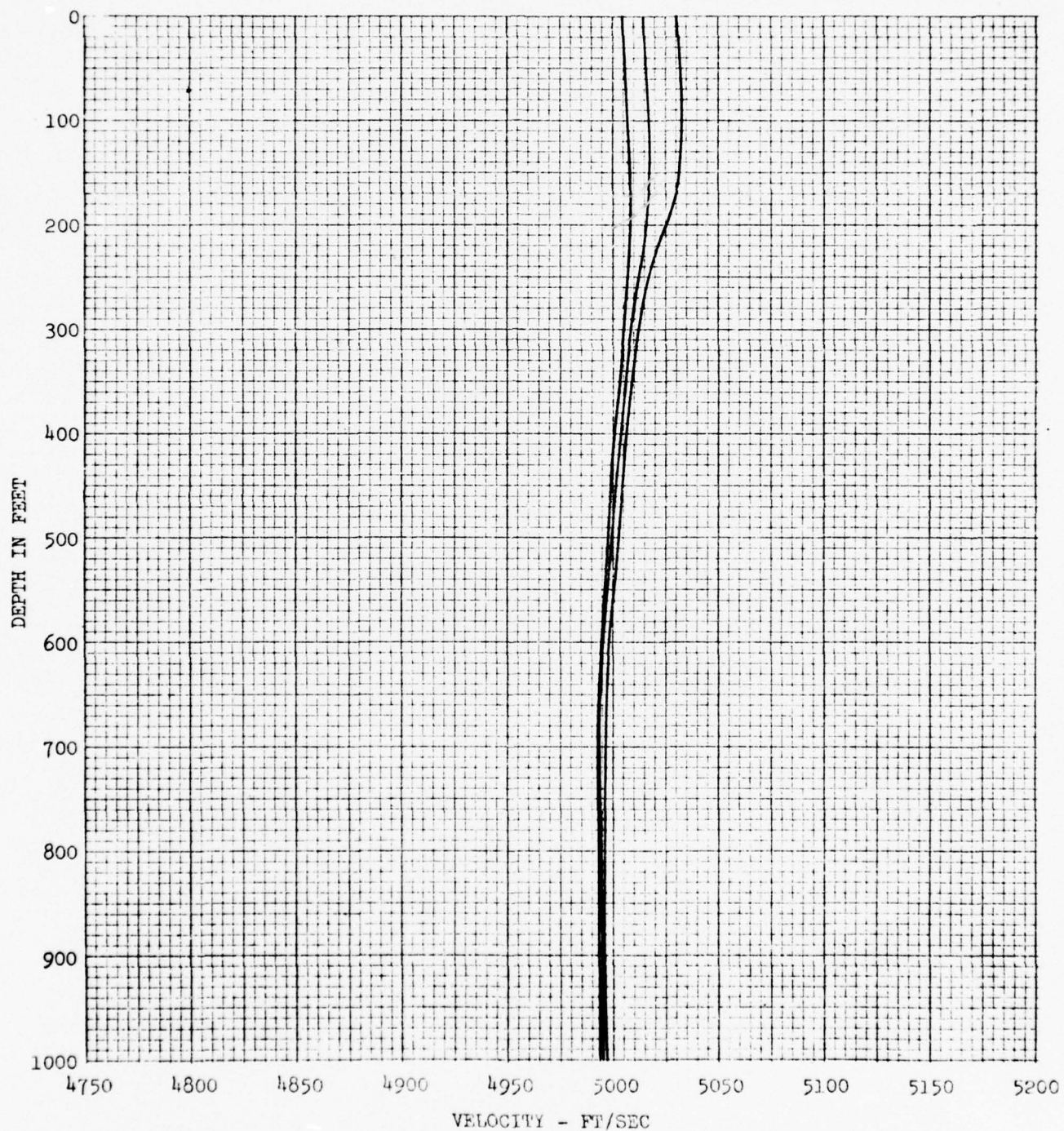


FIG. V.2. Near Surface Sound Velocity Statistical Quartile Plot, Fall

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CONFIDENTIALTABLE V.111
NEAR SURFACE STATISTICAL QUANTILES

LOCATION/AREA: NA-1

SEASON: FALL (OCT, NOV, DEC)

DEPTH - FT	SOUND VELOCITY - FPS		
	1ST QUANTILE	MEDIAN	3RD QUANTILE
0	5004.7	5015.0	5030.5
20	5005.0	5015.3	5031.0
40	5005.5	5015.6	5031.6
60	5005.9	5016.6	5032.0
80	5006.3	5016.3	5032.4
100	5006.7	5016.6	5032.6
120	5007.1	5016.9	5032.2
140	5007.4	5017.3	5031.7
160	5007.8	5017.6	5031.2
180	5007.7	5016.6	5028.4
200	5007.6	5015.4	5025.0
240	5007.3	5012.8	5018.2
280	5005.8	5010.0	5014.3
320	5004.2	5007.2	5010.9
360	5002.4	5005.2	5008.5
400	5000.6	5003.4	5006.3
440	4999.1	5001.7	5004.5
480	4997.6	5000.1	5002.7
520	4996.6	4998.6	5001.3
560	4995.7	4997.2	5000.0
600	4994.8	4995.9	4998.7
640	4993.9	4994.5	4997.4
680	4993.6	4994.0	4996.8
720	4993.7	4994.2	4996.7
760	4993.7	4994.4	4996.6
800	4993.8	4994.5	4996.4
840	4993.9	4994.7	4996.4
880	4994.0	4994.8	4996.4
920	4994.2	4995.0	4996.5
960	4994.3	4995.1	4996.5
1000	4994.4	4995.2	4996.7

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SECTION VI
MEASURED DATA

VI.1

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MEASURED VELOCITY PROFILES

LOCATION/AREA: NA-1

SEASON: WINTER (JAN, FEB, MAR)

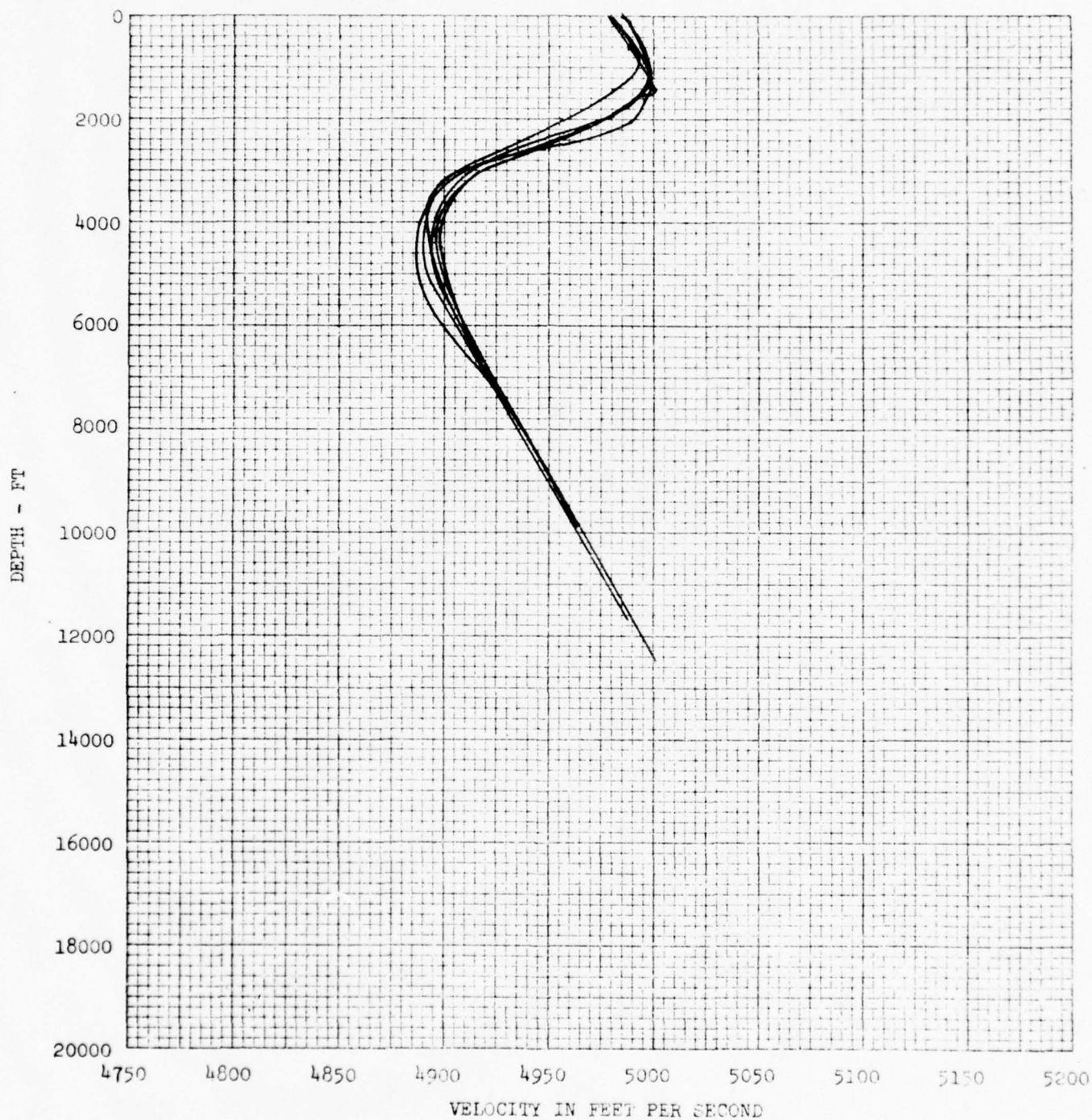


FIG. VI.1. Measured Sound Velocity Profiles from Station Data, Winter

VI.2

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MEASURED BATHYTHERMOGRAPH PLOTS

LOCATION/AREA: NA-1

SEASON: WINTER (JAN, FEB, MAR)

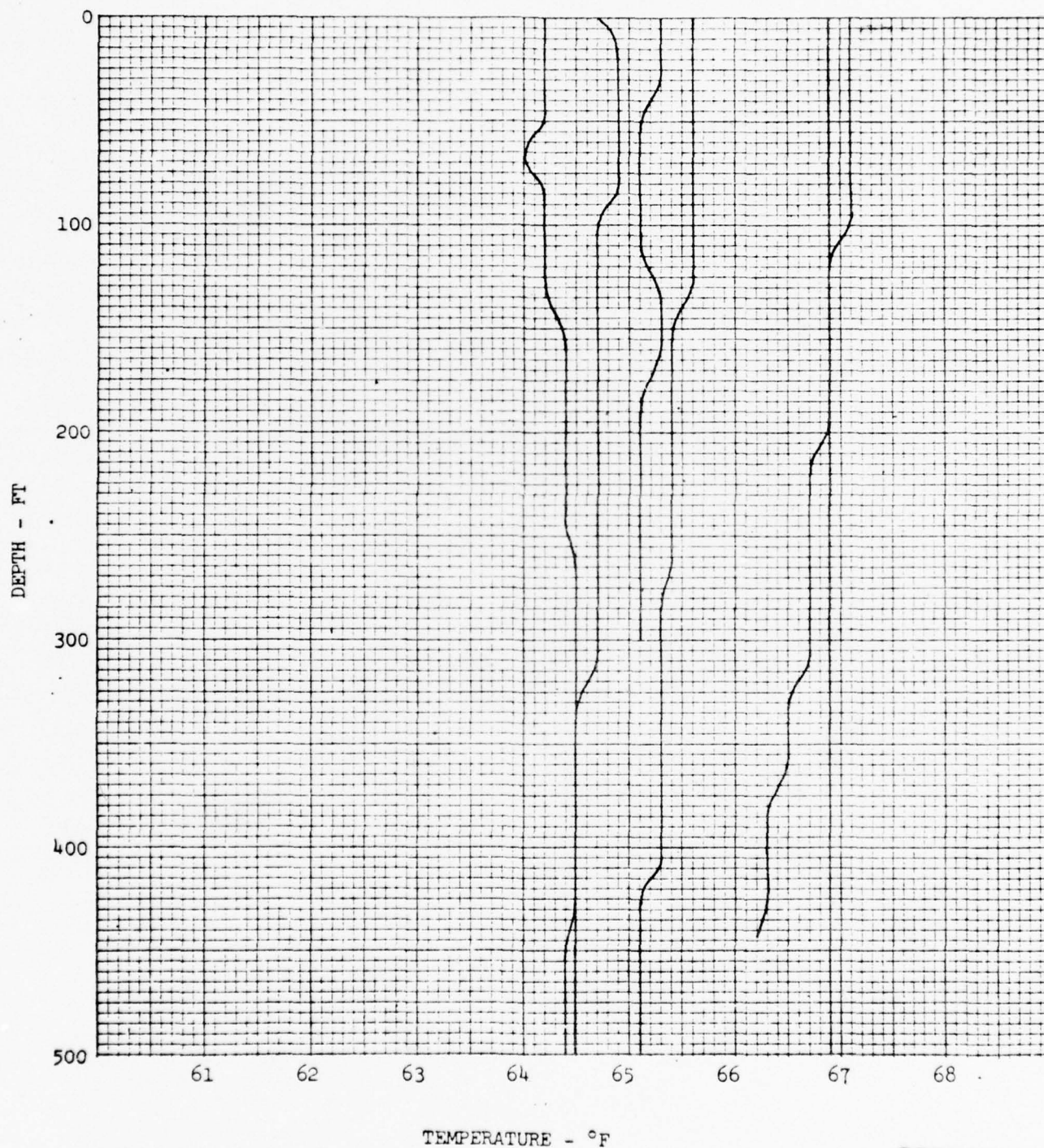


FIG. VI.2. Measured BT soundings, Winter

VI.3

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CONFIDENTIAL MEASURED VELOCITY PROFILES

LOCATION/AREA: NA-1

SEASON: SPRING (APR, MAY, JUN)



FIG. VI.3. Measured Sound Velocity Profiles from Station Data, Spring

VI.4

CONFIDENTIAL

CONFIDENTIAL

MEASURED BATHYTHERMOGRAPH PLOTS

LOCATION/AREA: NA-1

SEASON: SPRING (APR, MAY, JUN)

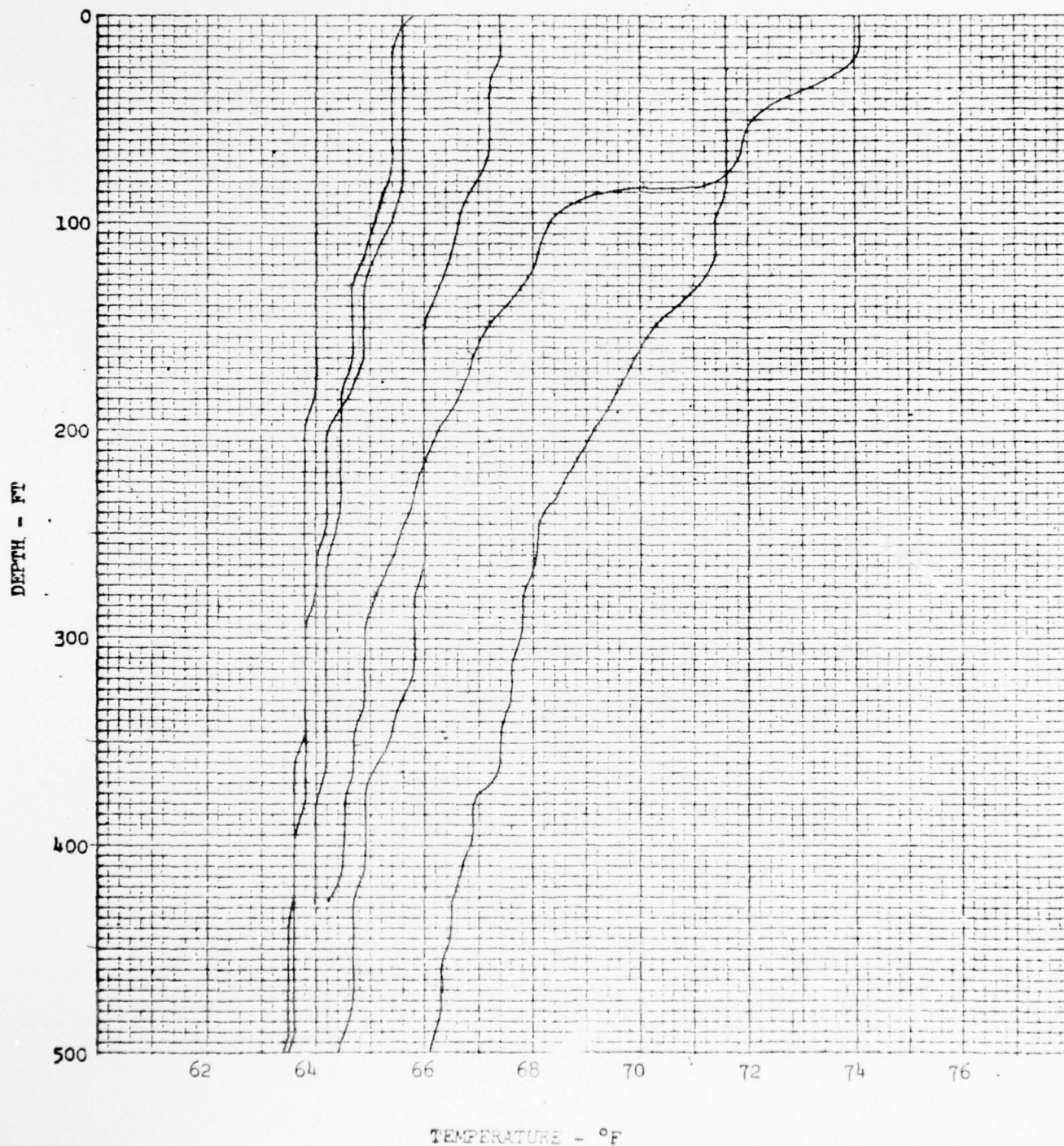


FIG. VI.4. Measured BT Soundings, Spring

VI.5

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CONFIDENTIAL MEASURED VELOCITY PROFILES

LOCATION/AREA: NA-1

SEASON: SUMMER (JUL, AUG, SEP)

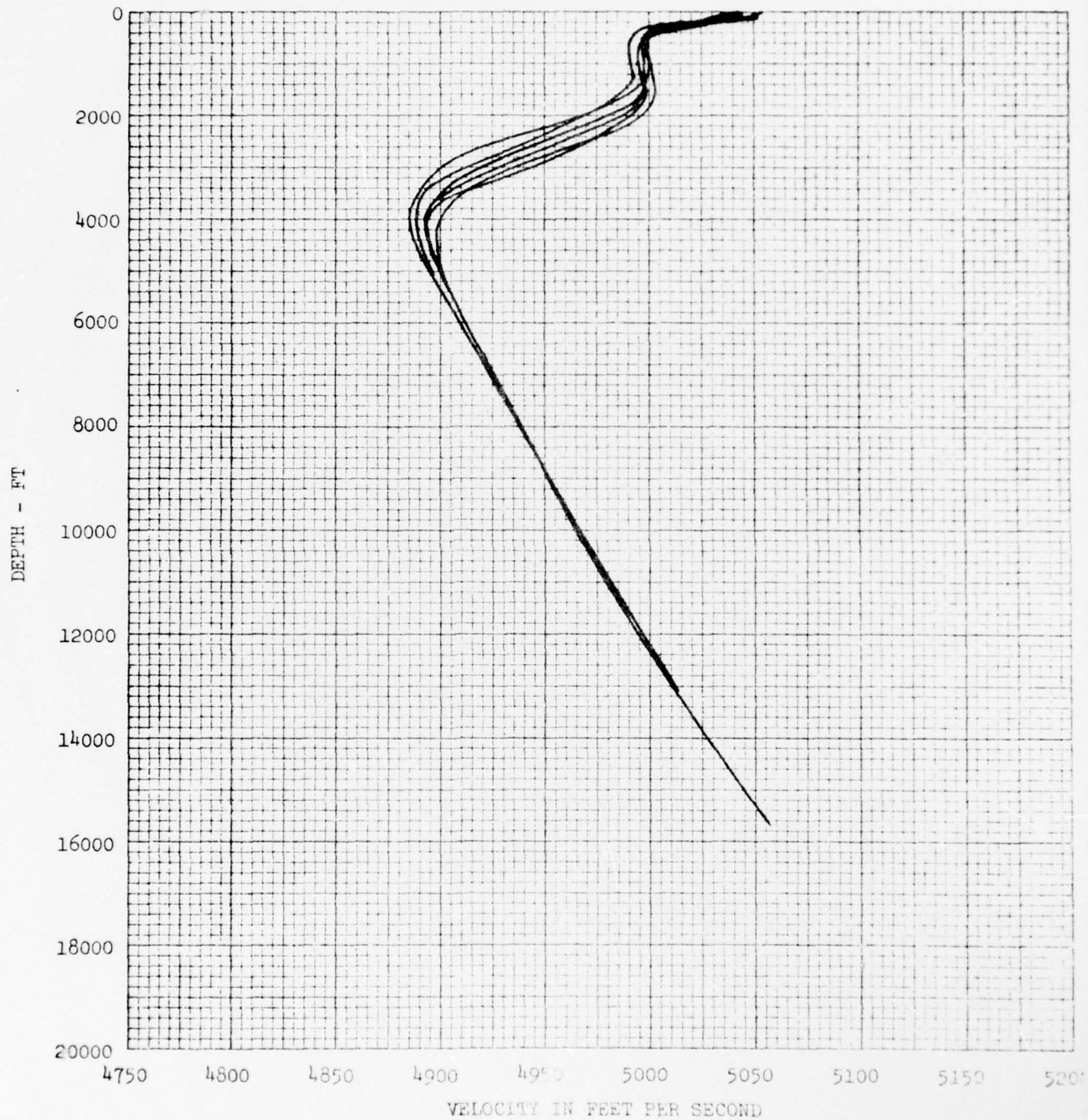


FIG. VI.5. Measured Sound Velocity Profiles from Station Data, Summer

VI.6

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MEASURED BATHYTHERMOGRAPH PLOTS

LOCATION/AREA: NA-1

SEASON: SUMMER (JUL, AUG, SEP)

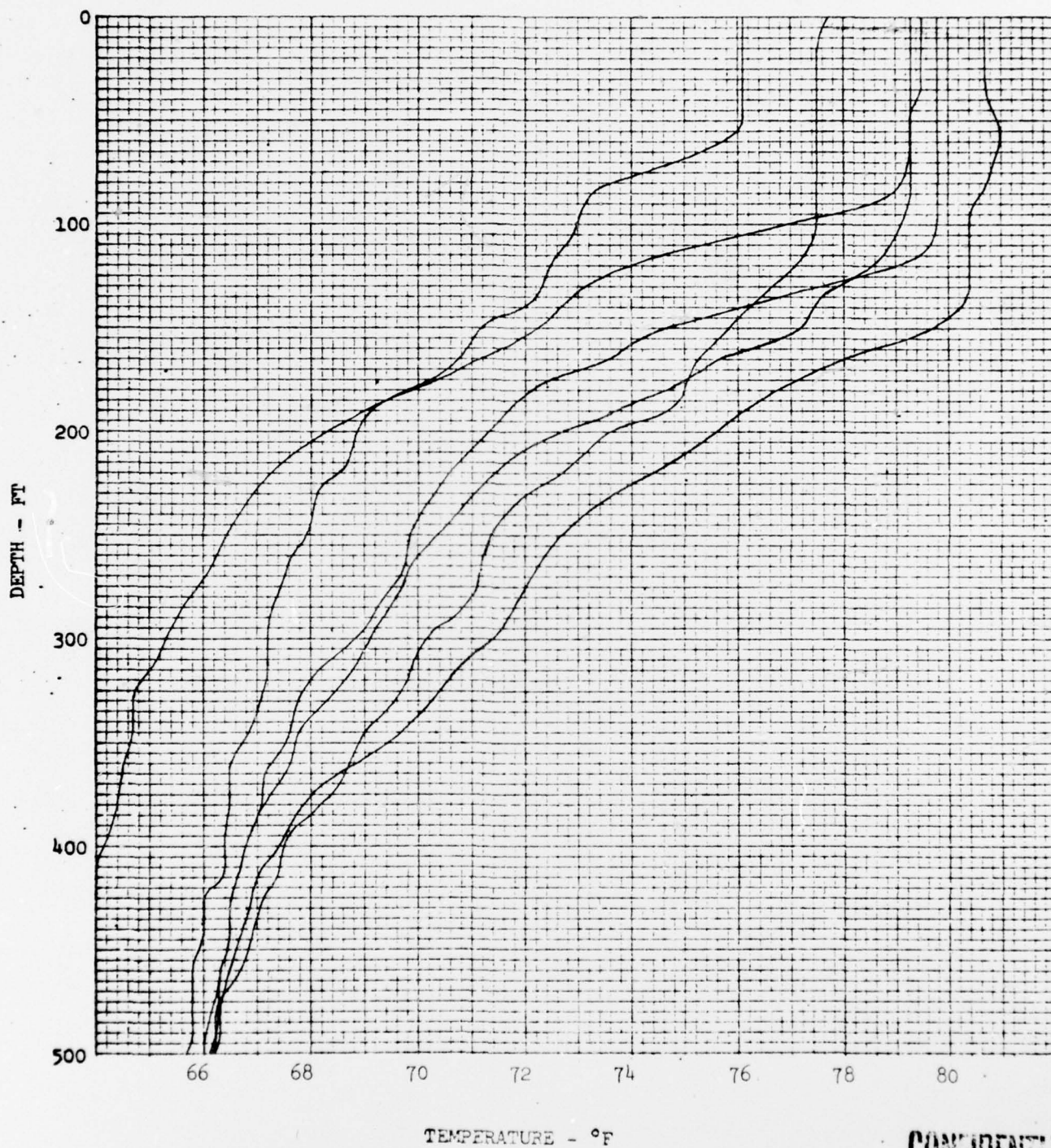


FIG. VI.6. Measured BT Soundings, Summer

VI.7

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MEASURED VELOCITY PROFILES

LOCATION/AREA: NA-1

SEASON: FALL (OCT, NOV, DEC)

BEST AVAILABLE COPY

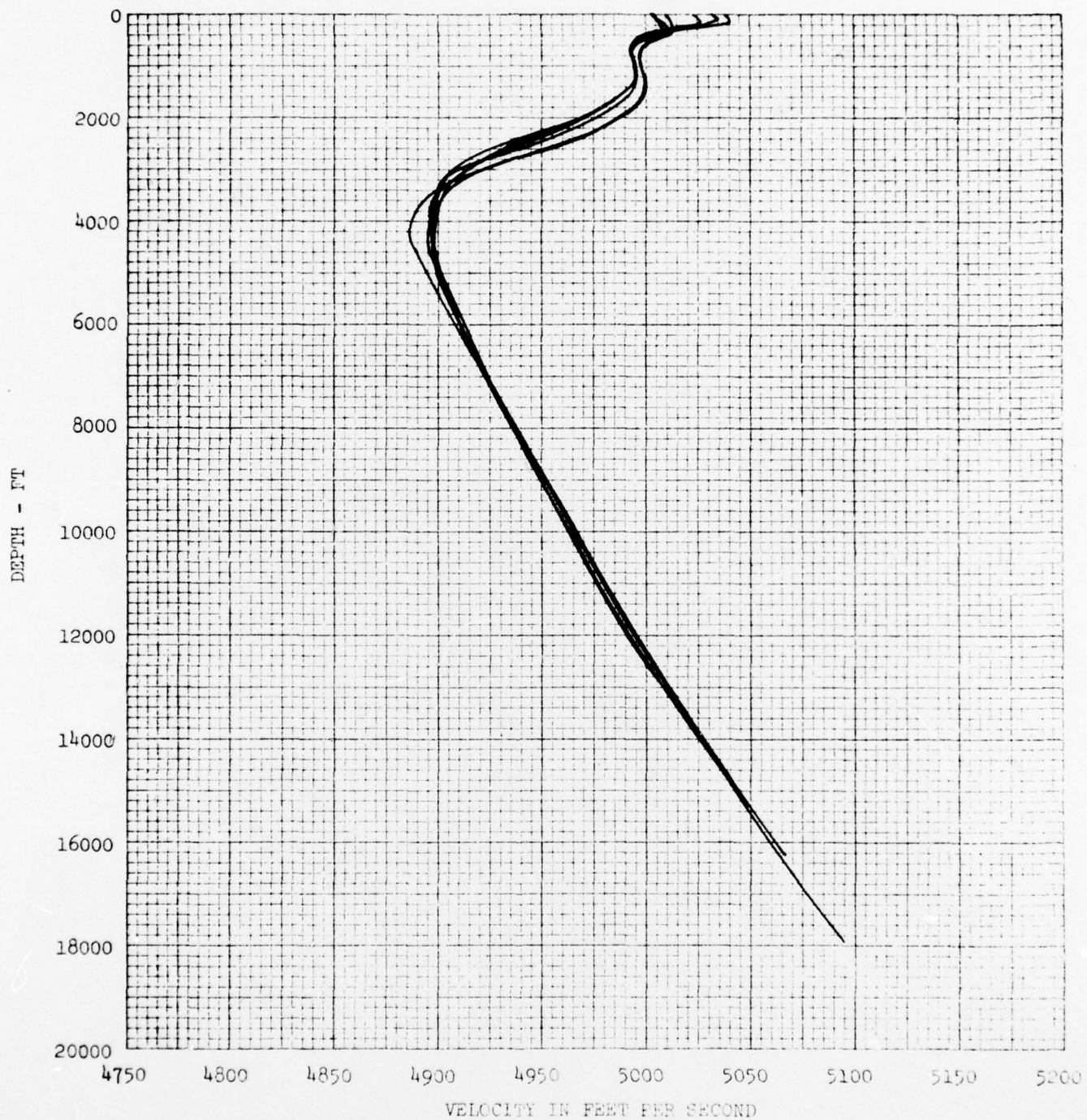


FIG. VI.7. Measured Sound Velocity Profiles from Station Data, Fall

VI.8

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MEASURED BATHYTHERMOGRAPH PLOTS

LOCATION/AREA: NA-1

SEASON: FALL (OCT, NOV, DEC)

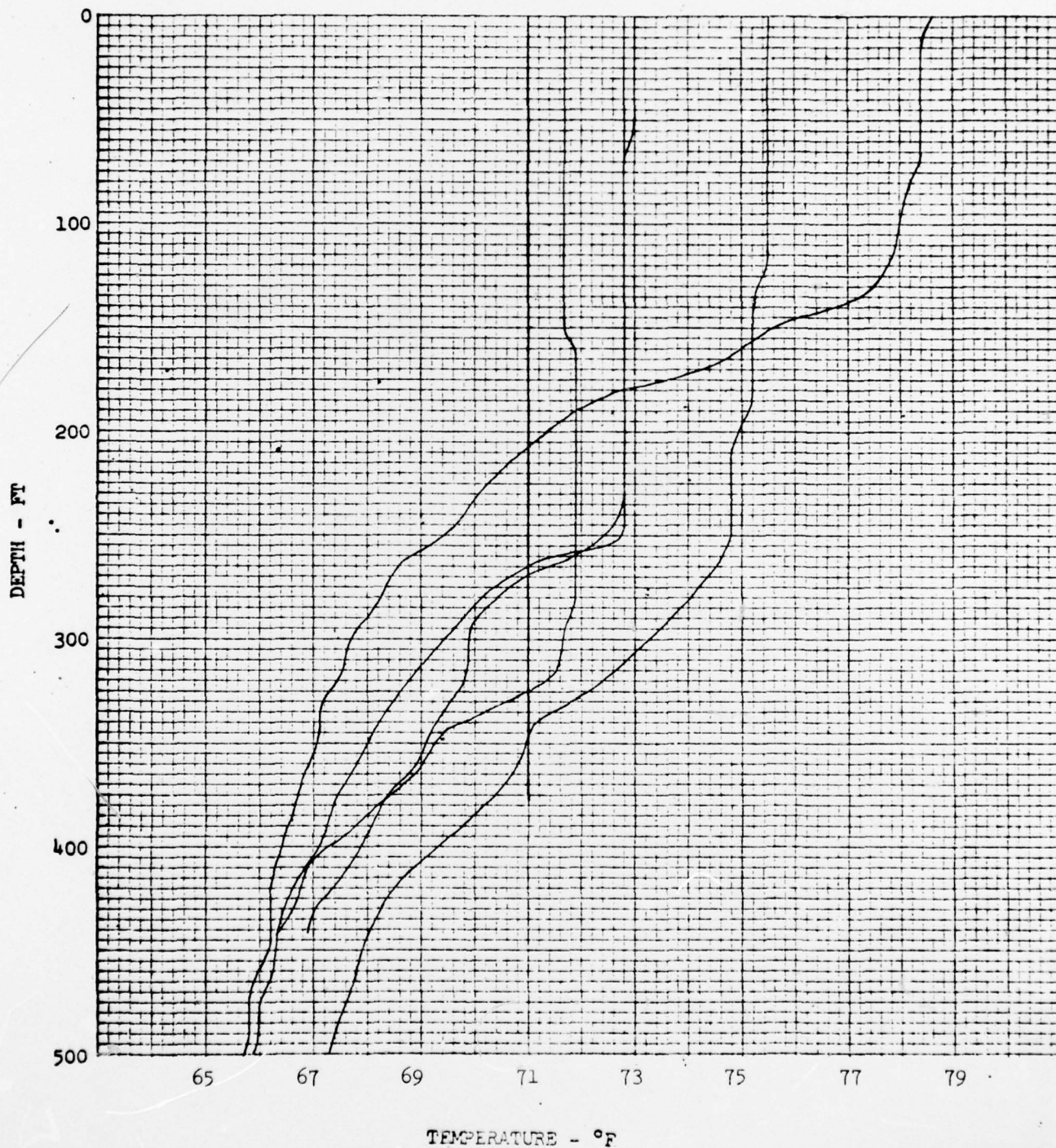


FIG. VI.8. Measured BT Soundings, Fall

VI.9

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SECTION VII
DATA DISTRIBUTION

VII.1

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TABLE VII.1

OCEANOGRAPHIC STATION AND BT DATA DISTRIBUTION
BY MONTH AND YEAR

	<u>Month</u>	<u>Year</u>	<u>No. of Stations</u>
WINTER	2	32	6
	TOTAL		6
SPRING	4	59	4
	4	60	22
	5	60	12
	6	57	8
	6	60	12
	6	64	3
	TOTAL		61
SUMMER	7	57	1
	7	58	1
	8	31	5
	8	41	3
	8	56	2
	9	49	2
	9	57	1
	9	59	6
	9	60	1
	9	61	4
	TOTAL		26
FALL	11	54	3
	11	55	1
	11	56	7
	11	57	1
	11	59	2
	TOTAL		14

VII.2

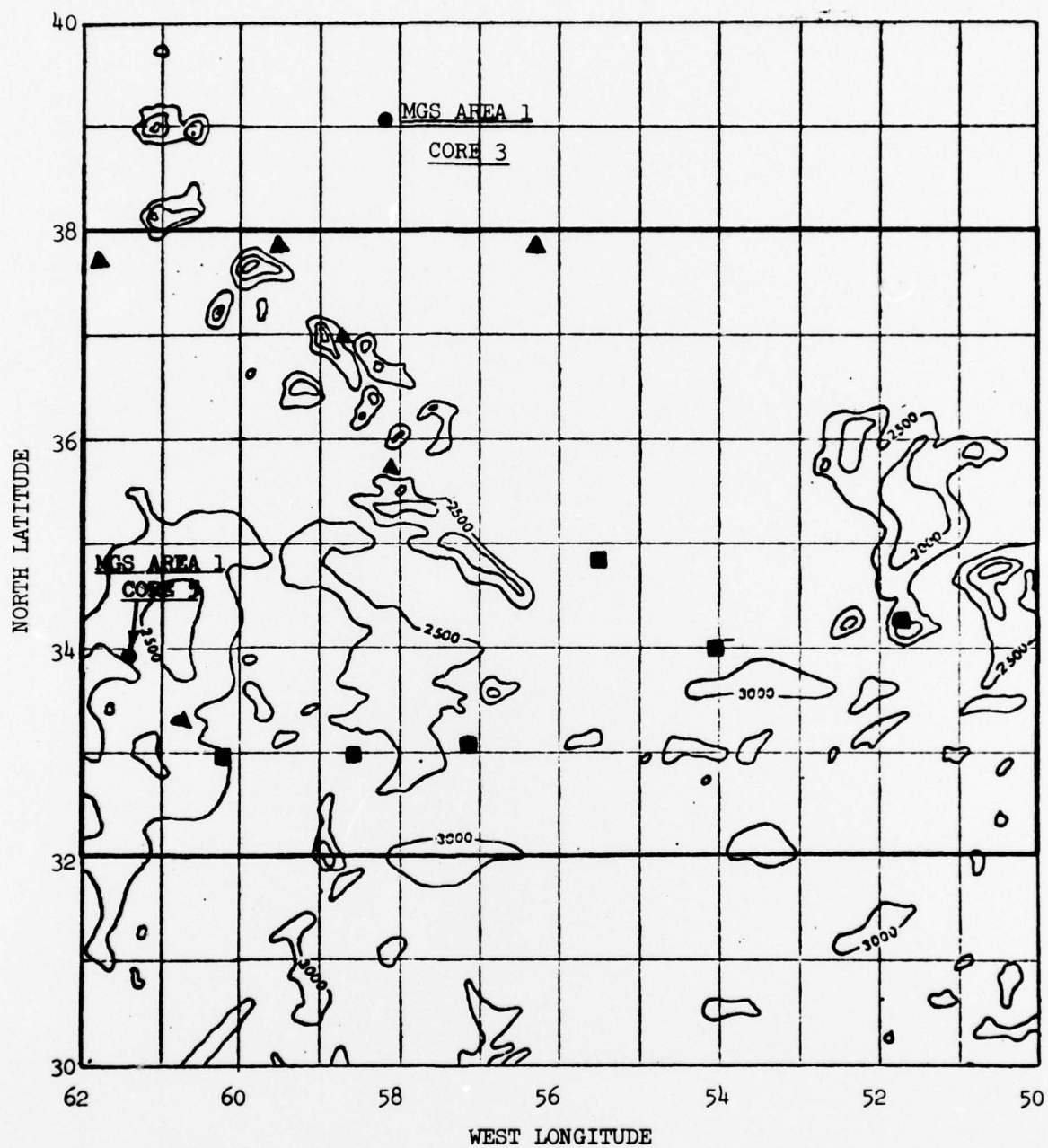
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DATA DISTRIBUTION

LOCATION/AREA: NA-1

SEASON: WINTER (JAN, FEB, MAR)



- Core location
- Plotted station data location
- ▲ Plotted BT data location

FIG. VII.1. Station Data Distribution

VII.3

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CONFIDENTIAL DATA DISTRIBUTION

LOCATION/AREA: NA-1

SEASON: SPRING (APR, MAY, JUN)

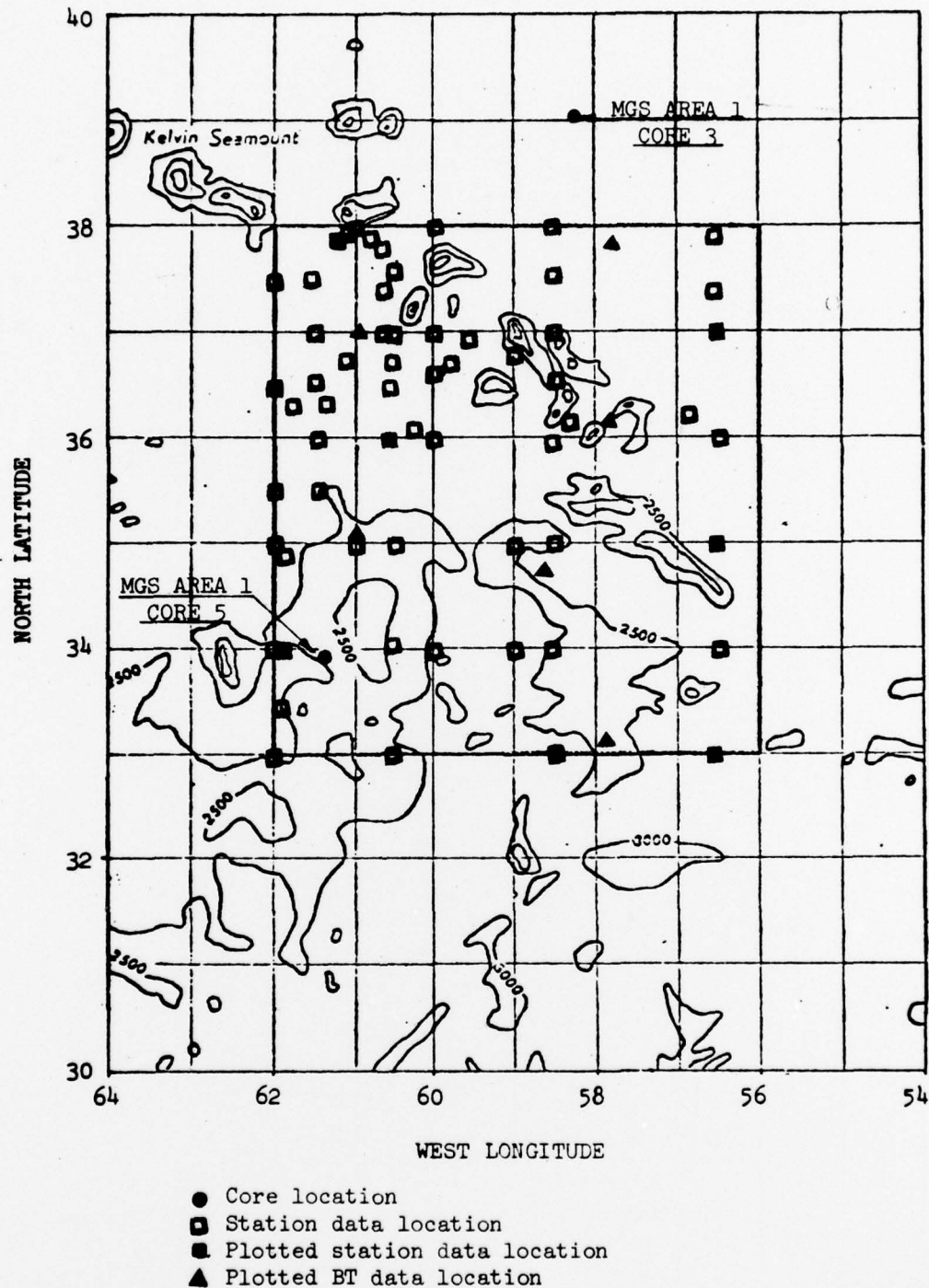


FIG. VII.2. Station Data Distribution, Spring

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DATA DISTRIBUTION

UNCLASSIFIED

LOCATION/AREA: NA-1

SEASON: SUMMER (JUL, AUG, SEP)

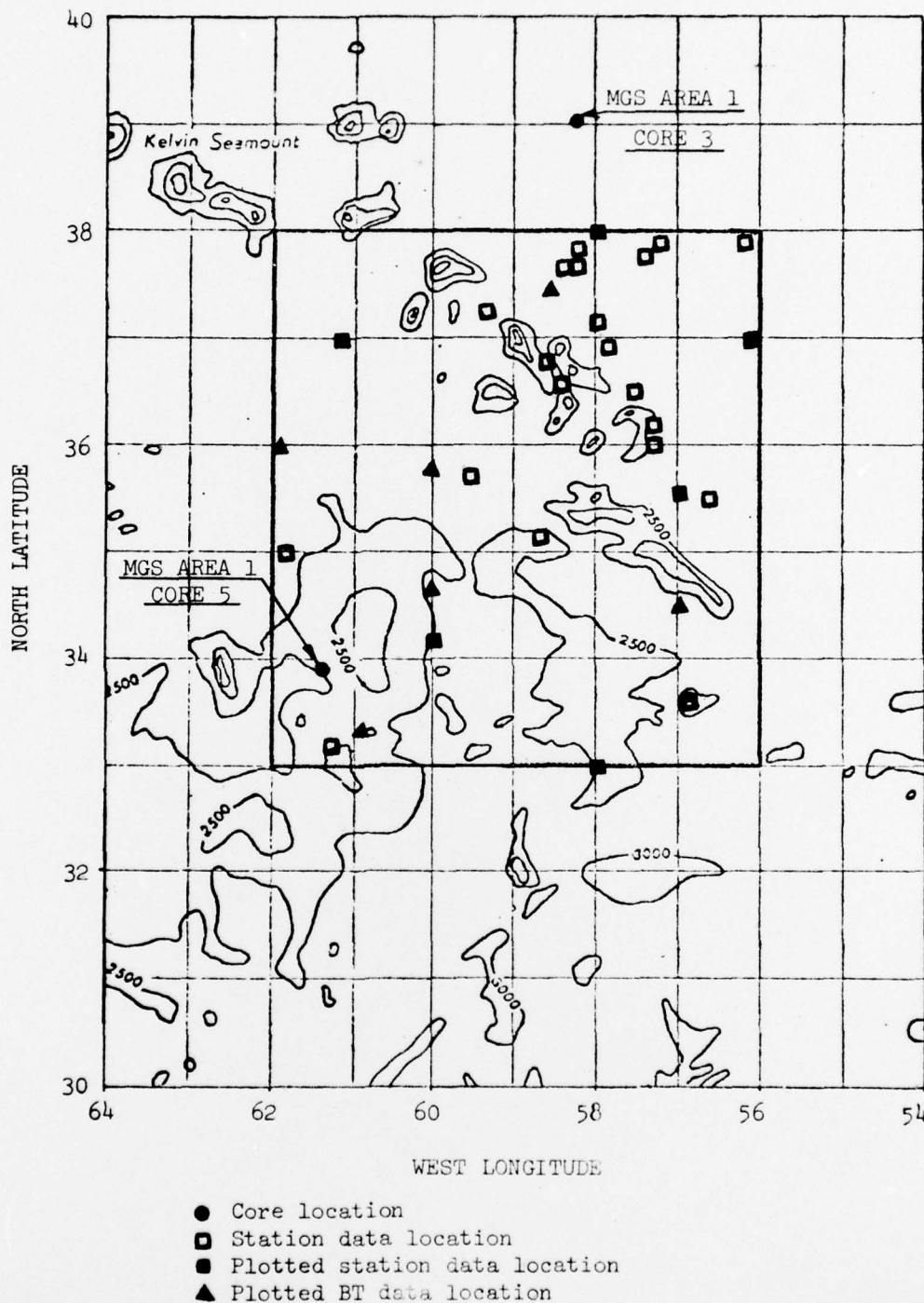


FIG. VII.3. Station Data Distribution, Summer

VII.5

UNCLASSIFIED

~~CONFIDENTIAL~~

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DATA DISTRIBUTION

LOCATION/AREA: NA-1

SEASON: FALL (OCT, NOV, DEC)

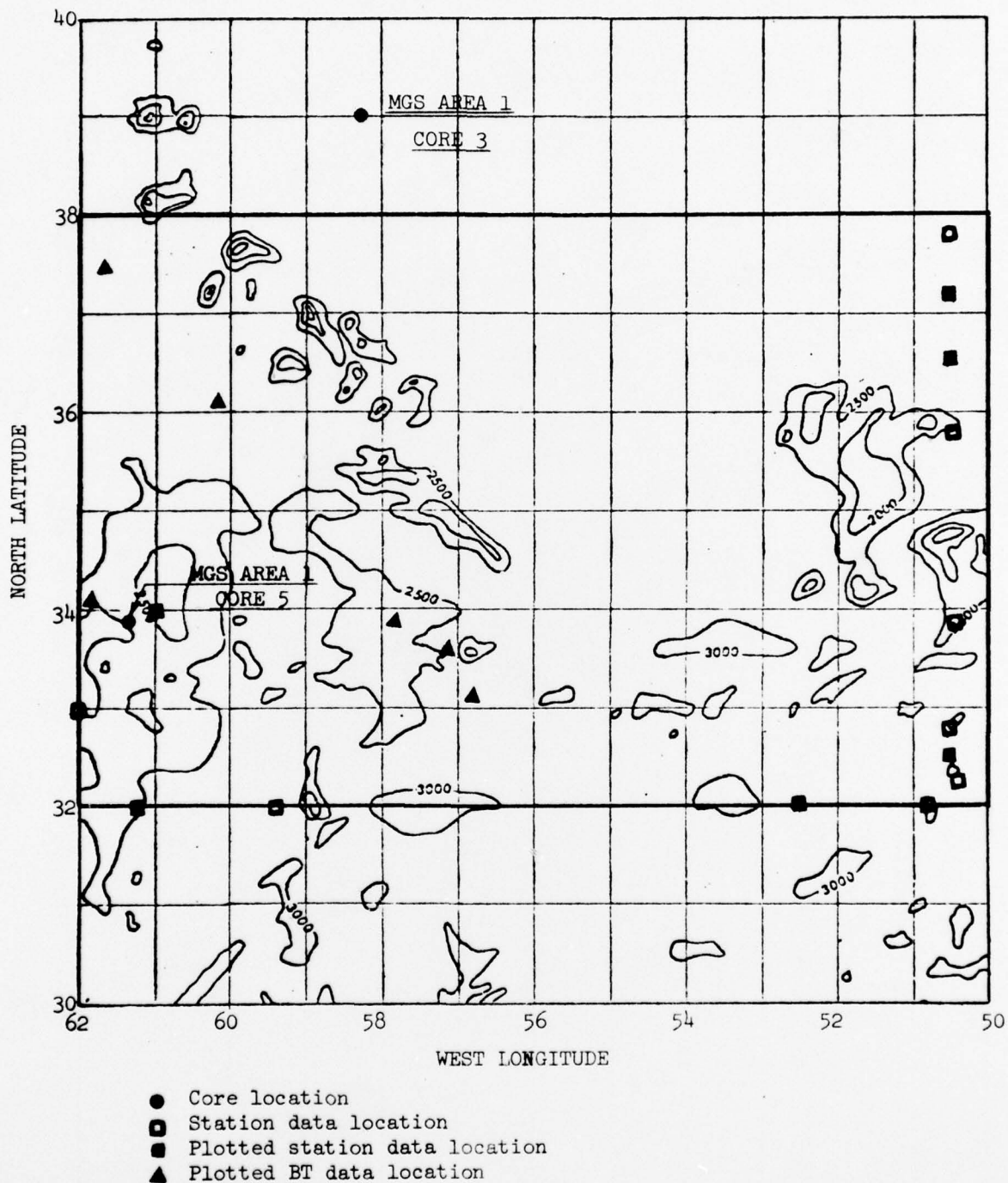


FIG. VII.4. Station Data Distribution, Fall

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SECTION VIII
SEA FLOOR SUMMARY DATA

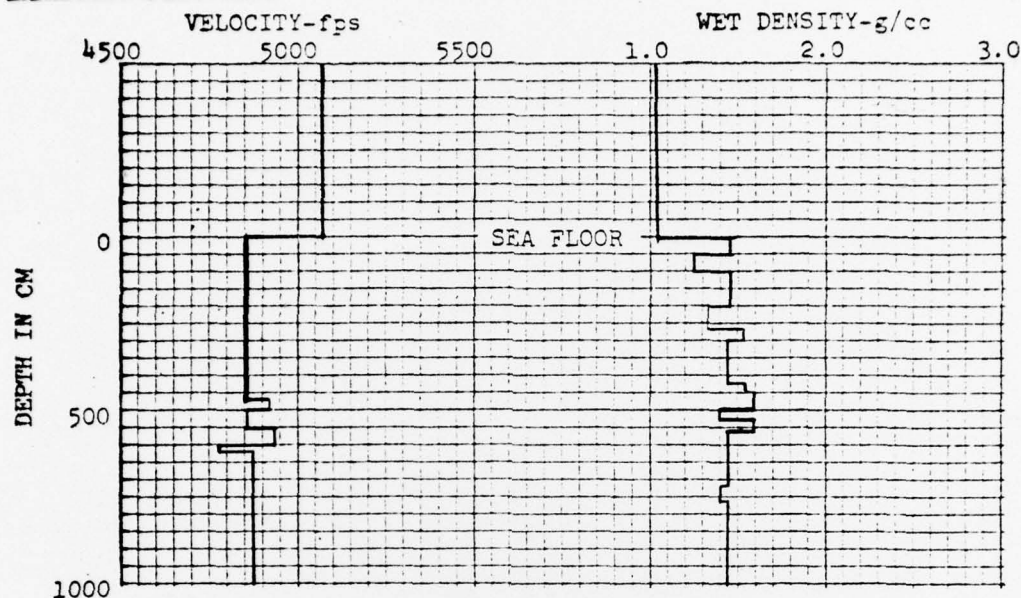
VIII.1

CONFIDENTIAL**ACOUSTIC SEA FLOOR SUMMARY**

LOCATION/AREA: NA-1

PROVINCE: Bermuda Rise

DATA SOURCE: NAVOCEANO SP 96-1-5, MGS Area 1 Core 5

I. DEPTH DISTRIBUTION:**II. LAYER CHARACTERISTICS:**

LAYER NUMBER	MATERIAL	LAYER DEPTH-cm*	LAYER THICKNESS cm	VELOCITY fps	POROSITY	WET DENSITY g/cc
1	Loose silty clay	0	475	4860	.75	1.466
2	Silt	475	50	4930	.60	1.60
3	Silty clay	525	50	4860	.77	1.40
4	Silt	575	100	4940	.60	1.60

III. SEA FLOOR INTERFACE VALUES:

BOTTOM WATER VELOCITY - fps	5075
BOTTOM WATER DENSITY - g/cc	1.0514
SURFACE SEDIMENT DENSITY - g/cc	1.46
SURFACE SEDIMENT TO BOTTOM WATER VELOCITY RATIO	.958
BOTTOM DEPTH - ft	16,800

*DEPTH TO UPPER SURFACE OF LAYER

FIG. VIII.1. Ocean Bottom and Sediment Characteristics

VIII.2

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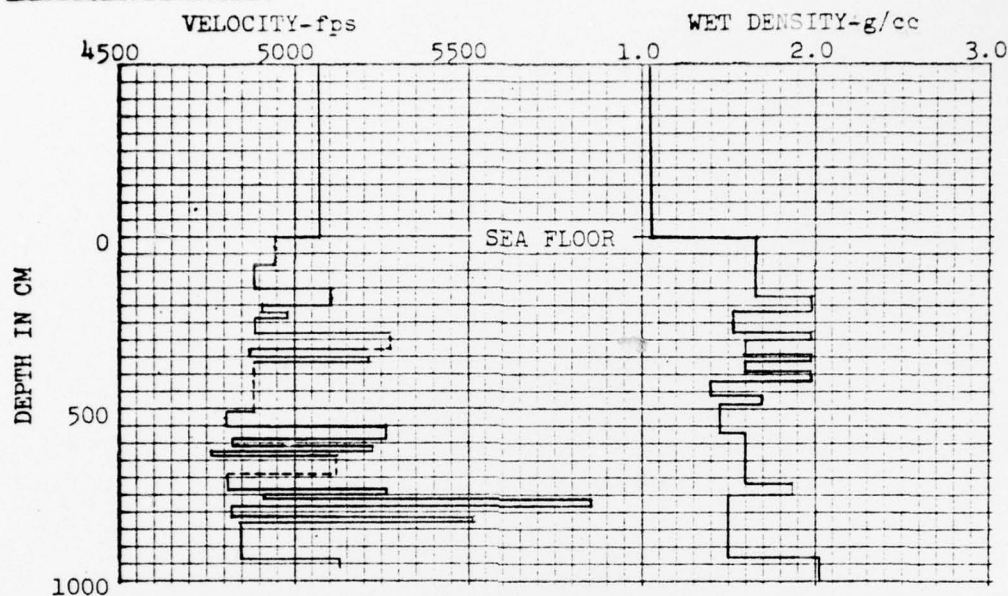
CONFIDENTIAL ACOUSTIC SEA FLOOR SUMMARY

LOCATION/AREA: NA-1,

PROVINCE: Sohm Abyssal Plain

DATA SOURCE: NAVOCEANO SP 96-1-5, MGS Area 1 Core 3

I. DEPTH DISTRIBUTION:



II. LAYER CHARACTERISTICS:

LAYER NUMBER	MATERIAL	LAYER DEPTH-cm*	LAYER THICKNESS cm	VELOCITY fps	POROSITY	WET DENSITY g/cc
1	Sandy clay	0	175	4940	.65	1.66
2	Silty clay	175	50	5120	.40	2.00
3	Clayey silt	225	50	4890	.68	1.55
4	Clay	275	325	5275	.40	2.00

III. SEA FLOOR INTERFACE VALUES:

BOTTOM WATER VELOCITY - fps	5070
BOTTOM WATER DENSITY - g/cc	1.0514
SURFACE SEDIMENT DENSITY - g/cc	1.66
SURFACE SEDIMENT TO BOTTOM WATER VELOCITY RATIO	.973
BOTTOM DEPTH - ft	16,800

*DEPTH TO UPPER SURFACE OF LAYER

FIG. VIII.2: Marine Geophysical Survey Area 2 Core No. AS2-8

VIII.3

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SECTION IX
REFERENCES

IX.1

UNCLASSIFIED

REFERENCES

1. Navy Electronics Laboratory Report 892, Sound Velocity Distribution from 3000 Meters to the Bottom in the North and South Pacific, by E. R. Anderson, CONFIDENTIAL, 16 April 1959.
2. Naval Undersea Warfare Center Technical Publication 9, Oceanometrics as Related to Sound-Field Prediction - A Review of NEL Research from 1953 to 1966, by E. R. Anderson, CONFIDENTIAL, October 1967.
3. Batzler, W. E., and Vent, R. J., "Volume-Scattering Measurements at 12 kc/sec in the Western Pacific," Acoustical Society of America. Journal, v. 41, p. 154, January 1967.
4. Chapman, R. P., and Marshall, J. R., "Reverberation from Deep Scattering Layers in the Western North Atlantic," Acoustical Society of America. Journal, v. 40, p. 405, August 1966.
5. Hamilton, E. L., "Prediction of the Sea-Floor Sediment Acoustic Properties and Models, North Pacific," Proceedings, 24th Navy Symposium on Underwater Acoustics, Philadelphia, Pennsylvania, CONFIDENTIAL, December 1966.
6. Sverdrup, H. W., Johnson, M. V., and Fleming, R. H., The Oceans, Ninth Printing 1960, Englewood Cliffs, N. J., Prentice-Hall, Inc.
7. U. S. Naval Oceanographic Office, "Oceanographic Atlas of the North Atlantic Ocean," Publication No. 700, vol. 7, 1965 and sec. II, 1967.
8. U. S. Naval Oceanographic Office, "Marine Geophysical Survey Program 1965-1967 Area 2," Special Publication 96, vol. 5, 1968.
9. U. S. Naval Oceanographic Office, "Marine Geophysical Survey Program 1965-1967 Area SF," Special Publication 96, vol. 5, 6 and 8 (1967), vol. 8A (1966).
10. U. S. Naval Oceanographic Office, "World Atlas of Sea Surface Temperatures," H. O. Publication No. 225, Second Edition, 1944.

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